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# East Europe Report

SCIENCE AND TECHNOLOGY

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2 December 1985

# EAST EUROPE REPORT

## SCIENCE AND TECHNOLOGY

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GERMAN DEMOCRATIC REPUBLIC

PHYSICAL ASPECTS, USE OF TECHNICAL INTELLIGENCE AIDS

East Berlin MILITAERTECHNIK in German Vol 6 No 3, 1984

/Article by Dr. R. Lehmann/

/Text/ 1.2.3 Reception of the Information Source

The ready detection of enemy objects presupposes not only contrast in the emitted radiation from the information source and optimal propagation conditions in the atmosphere but also the existence of suitable receiving sensors. Suitable means that the actual information source can interact with the sensor of the reconnaissance medium.

Presently available photo-optical, opto-electronic, and electronic reception methods express the purposeful utilization of all the physical properties of the relevant information sources. IR sensors, which are installed in the focal plane of special IR lenses exhibit the following detection effects:

In active IR night vision units (image converter units), the sensor is designed as a photo cathode, where the external photo-electric effect takes place. This effect appears when IR photons, in virtue of their energy  $h \cdot \nu$ , release free electrons from certain metallic surfaces, especially cesium compounds. The electron density that is produced here at a surface element of the sensor is proportional to the photon density. But it should be noted that even the most sensitive photo cathodes, due to their specific work function, can react only to IR radiation with at most  $1.2 \mu\text{m}$  wavelength, that is the near infrared. This is the radiation which is emitted by IR searchlights. The medium IR of the inherent heat radiation from the reconnaissance objects accordingly cannot be perceived by such sensors.

Most of the so-called long-distance optical reconnaissance instruments (prism binoculars, optical range finders, shear jointed telescopes, and the like) are in no way limited to use by day. They have available non-imaging passive sensors for IR radiation. Non-imaging means that they cannot detect enemy heat targets in terms of their size and contours, but that only IR searchlights are located and are detected as a light spot. In such sensors, a form of phosphorescence occurs, namely thermal luminescence. The sensor material is previously brought to a metastable level by irradiating it with light (the lifetime is several hours). The incident IR radiation initiates the luminescence. The searchlight can now be detected without further signal conversion. In this case, too, the response exists only for light and for the near infrared.

The most modern IR reconnaissance units are the thermovision or heat imaging units. The sensitivity of their sensors for long-wave radiation of the medium IR makes it possible to display the heat-radiation conditions of the battlefield as a visible bright-dark picture. Two types of sensors must be distinguished here. In pyroelectric targets, there is a pyroelectric effect. In certain crystals, for example triglycine sulfate and triglycine sulfide, electric charges form on opposite crystal surfaces when there is a sudden temperature change. The heat image of the scenery thus appears as an analogue electrostatic charge distribution on the sensor surface. By means of an electron beam, this charge distribution can be scanned and can be converted into an electric signal.

Some semiconductor photocathodes, for example those made from CdHgTe and from InSb, are used as IR sensors. Here, when heat radiation is incident, the interior photo effect is initiated. The energy of the IR photons is sufficient to raise electrons from the valence band into the conduction band of the molecular structure. The electrical conductivity of the sensor material thus changes. Analogous to the external photo effect involved with photocathodes, it is also true here that the amplitude of the resulting electrical signal is proportional to the photon density. In a sensor mosaic, composed of many small sensor wafers (about 15  $\mu\text{m}$  edge length), the heat image is converted in this fashion into a more or less well-resolved "charge image" of discrete electrical signals.

#### 1.2.4 Signal Conversion in the Reconnaissance Unit

A characteristic feature of modern reconnaissance technology consists in the need to detect, if possible, all objectively existent information sources, by means of which objects can be unmasked. Light and sound have become equal partners as information sources, namely heat radiation, microwave radiation, and infrasound. Odors are also being considered. The reception of the above information sources lies outside human sensory perception, so that the signals generated upon reception first must be converted in a suitable fashion. At the end of this signal conversion, reconnaissance information which can be perceived by an observer should finally be available. The structure and mode of operation of technical systems of signal conversion, of the detectors, depend on the type of sensor. Here too we will refer to IR reconnaissance methods.

The photocathodes of active IR night vision units and passive residual light amplifiers are components of image converter tubes and image amplifier tubes. The two are not different as regards their basic mode of operation. In the interior of an image converter tube (Figure 5) one finds a cathode and an anode, generally of cylindrical shape. The shape of the electrodes has as its consequence that, when a high voltage is applied, a lens-shaped electric field forms between them, namely the "electron lens." The "electron image" is produced at the photocathode by the IR image by means of the external photo-electric effect. This is accelerated in the electron lens, is focused, and is inverted. Finally, by the electrons that are incident on the luminescent screen, it is converted into a visible image. By means of a subsequent ocular, the bright-dark image, which is generally green in color, can be viewed and evaluated. The color depends on the material of the screen.

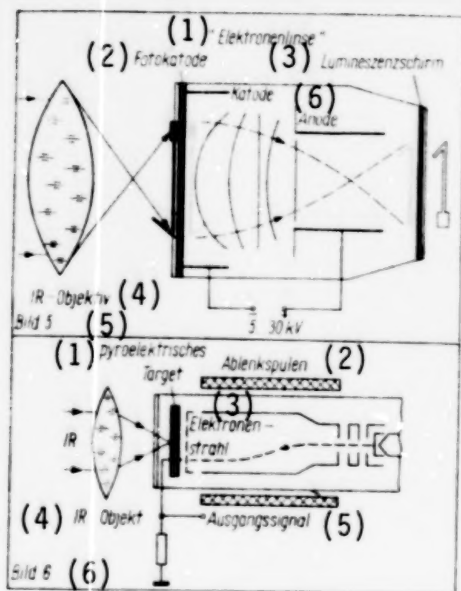


Figure 5: Principle of the Electronic Image Converter

Key:

- |                       |            |
|-----------------------|------------|
| 1. Electron lens      | 6. Cathode |
| 2. Photocathode       |            |
| 3. Luminescent screen |            |
| 4. IR lens            |            |
| 5. Figure 5           |            |

Figure 6: Pyroelectric Vidicon

Key:

- |                        |
|------------------------|
| 1. Pyroelectric target |
| 2. Deflection coils    |
| 3. Electron beam       |
| 4. IR lens             |
| 5. Output signal       |
| 6. Figure 6            |

Image converter tubes are single-stage, since the radiation intensity of the sensor is sufficiently large due to the use of a searchlight. Image amplifier tubes can have two to three stages, to amplify the weak residual intensity to the required extent. Modern units, however, are also possible in one stage. The necessary amplification is reached by an SEV (secondary electron multiplier) up to a factor of  $10^5$ .

With heat-image reconnaissance, two different principles of signal conversion are used, corresponding to the two variants of sensors, namely the pyroelectric vidicon and opto-electronic or electronic multiplexing. The pyroelectric vidicon or also pyricon (Figure 6) differs from other heat-image units in virtue of the fact that only one sensor surface is present, which is scanned point by point by means of an electron beam, and that its sensor responds only to temperature changes. Thus, time-chopping of the incoming radiation is necessary.

Heat-image units with semiconductor sensors are also called "quantum detectors." The sensor mosaic is composed of rows and columns. Its total surface just fills up the image field of the IR lens. To save sensor elements and better to solve the problem of preamplifiers for each of these elements, device types have been developed which have only one row of sensors, over which the image field must be swung. The resultant charge image can be scanned electronically point by point and line by line. A certain set of parallel electrical signals is thus converted into a signal train (multiplexing), which is appropriately amplified, and which then can activate the electron beam of a remote monitor or an LED display. The heat image has been made visible in acceptable quality (see Figure 3).

As regards signal conversion, the following generalization can be made:

The stages "IR image - electron image - visible image" in image-converter units or respectively "heat-image - charge image - visible image" in heat-image units have in common the feature that incident radiation is converted into electrical

signals before the observer can perceive anything. If the total modern reconnaissance technology is analyzed in this direction, the same features will be observed in the majority of cases. The reconnaissance information from many information sources in the area of the electromagnetic spectrum (UV, IR, radio measurements) and from the area of the sound spectrum are transferred, through the intermediate stage of electronic signal conversion, to perceptible information media, light, or audible sound.

## 2. Conclusions for the Use of Reconnaissance Technology

The tactical value of an observation method is guided not only by the technical sophistication of the device. An entire complex of physical aspects decides the deployment capability and the quality of the achieved reconnaissance results.

The person responsible for deploying reconnaissance technology must be clear about the most essential physical principles (a precondition of evaluating the available technology and for personal qualification in connection with new equipment).

Starting from the basic physical structure of information transmission, always considering the dialectics of observation and camouflage, he must acquire knowledge concerning the following central points:

- the place of the particular information source within the electromagnetic spectrum or the sound spectrum,
- the wavelength, frequency, and other essential physical properties of the information source,
- radiation processes (emission, reemission) and camouflage possibilities,
- atmospheric conditions which limit the range due to scattering and selective absorption,
- physical interactions between the sensor and the information source,
- basic principles concerning signal conversion.

On such a basis, comparisons can be made between different reconnaissance means, and the performance parameters of the technology can be deliberately and purposefully exploited. Thus, one can relatively quickly become accustomed to new developments in this field.

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CS0: 8120/0060

GERMAN DEMOCRATIC REPUBLIC

INSTITUTE DIRECTOR ON MATERIALS, SOLID-STATE PHYSICS RESEARCH

East Berlin PRESSE-INFORMATIONEN in German No 61, 30 May 85 p 5

[Article by Prof Dr Johannes Barthel, Director, GDR Academy of Sciences  
Central Institute for Solid-State Physics and Materials Research]

[Text] The primary objective of our institute is to contribute to increased performance within the national economy by providing results in the area of research on materials and associated technologies. New information on the manufacture and behavior of solid bodies forms a basis for obtaining long-term advantages and at the same emphasizes those results which can be used in industry.

Modern materials research at our institute provides for close ties between the development of new materials and the physically based advanced technologies required for producing and employing them. These new materials and their production technologies are used in microelectronic components, tools for machining metals and processing non-metals, and machine construction.

Complex Approach Necessary

New advances in materials research, for example in the development of VLSI (very large-scale integration) circuits or in processing metallurgy, require a complex approach in terms of producing, characterizing and investigating material properties. This means materials with a well-defined chemical and physical structure, i.e. specific properties such as great hardness for metal tools, for example, or resistance to fracture.

One result of our targeted search for materials with well-defined properties is a newly developed aluminum oxide ceramic cutting material for the machining of metals. Tiny cracks produced during surface treatment increase the strength of the ceramic material and make it possible to utilize the great hardness and temperature as well as the chemical resistance of aluminum oxide despite its brittleness.

Other results of this type of research are mechanically resistant metal carbide or metal carbonitride coatings. The HU 510 universal indexable insert, for example, is distinguished by a metal alloy coating, which was developed by our institute together with the Immelborn VEB Hard Alloy Plant. Such coated

indexable inserts have one major advantage over standard cutting tools: They can be rotated several times as they become dull and can then be replaced. This permits greater productivity by about 50 to 80 percent due to increased tool life and greater cutting speeds.

Together with researchers from the Schmalkalden VEB Tool Combine we have in the meantime succeeded in developing a new kind of coating system for universal indexable inserts employing a complicated production process. With this process wear is reduced even further. Together with our partners we hope to introduce this production process into industry by the time the 11th SED Congress convenes.

On the basis of physical data, further advances have been made recently in the area of processing metallurgy. With the aid of a thermomechanical steel treatment, the fundamentals of which were established by scientists at our academic institute, it was possible to create structures within the structural steels used in prestressed concrete which would reduce expenditures for alloying elements and for production in general. Stronger weldable steels for use in construction are already produced thermomechanically at the Ilsenburg VEB Rolling Mill.

#### New Ideas for Models

The so-called metallic glasses form a new class of material. They are obtained by rapid solidification of the molten mass. In this process the nearly freely moving atoms are "frozen," and the characteristic crystallization of the metal does not occur--intentionally. This provides very favorable properties in terms of utility, such as great mechanical strength and corrosion resistance. New ideas for models and greatly refined experimental methods lead us to expect additional information on the structure and on the technically significant properties of these materials within the next few years.

In the development of materials with special mechanical properties, the goal of controlling internal stresses has recently arisen. Even though it is also not yet possible today to define the distribution of stresses experimentally with great enough precision, it has already been possible to calculate this distribution of stresses with enough relative accuracy for different solid-states. Most importantly, further advances in this area can promote the use of new kinds of ceramic materials.

12552

CSO: 2302/107

GERMAN DEMOCRATIC REPUBLIC

MINISTER ADDRESSES RESEARCH COOPERATION IN CHEMICAL INDUSTRY

East Berlin PRESSE-INFORMATIONEN in German No 55, 16 May 85 p 2

[Article by Dr Guenther Wyschofsky, Minister for Chemical Industry]

[Text] Achieving peak scientific and technical performance is among the most important competitive obligations of the collectives of the chemical industry prior to the 11th SED Congress. With the introduction of new products, processes and technologies they are taking an important step toward greater refinements in chemical production and more rapidly expanding capital replacement. Results to date in the intensification of entire production lines and the methods thus employed, for example intensification of the entire line of polyurethane products, complex streamlining of tire production or introducing the rapid spinning process for fine polyamide silk, are the basis for further efforts.

By means of scientific cooperation, joint implementation collectives and complex competition, it was possible for researchers, users and equipment manufacturers, with the rapid spinning process, to combine the classic processes of drawing and spinning into one step. Thus it is possible to expand the amount of available fine silk by a fabric production value of 180 million marks and to increase labor productivity by a factor of 2.4. In producing fine polyamide silk the continuing step-by-step conversion of production is leading to a degree of renewal of 50 percent.

Increased Performance Promoted by Process Analyses

In the targeted and complex penetration of production processes and systems in scientific and technical terms, process analysis today has become the standard method used for intensification within the chemical industry. As an example for the entire national economy, this method was developed jointly with institutes of the Academy of Sciences of the GDR and was applied in conjunction with the scientific departments of the advanced schools and technical schools. Joint working groups were created which concentrated on performing process-analysis investigations into selected important production lines. This proved successful both in the startup phase at new plants and in stabilizing and expanding existing plants.

Within the chemical industry the Piesteritz VEB Agrochemical Combine is a pace setter in this area with regard to intensification at ammonia plants. Based on a complex process analysis which dealt with the entire production sequence up to and including maintenance, it was possible to achieve useage figures at the plant of over 95 percent which is a full 12 percent above projected capacity. One million cubic meters of boiler feedwater were able to be conserved; the work produces no by-products. The nine patents and the 5 licenses granted attest to the scientific and technical level of these solutions.

In order to realize a new era of economic strategy, the 9th Congress of the SED central committee recognized as essential the creation of a high level of scientific and technical advancement, strengthening of our own scientific and technical potential and cooperation in true partnership with the Academy of Sciences and the advanced schools and technical schools. General agreements have been an important basis for cooperation with the Academy and the universities and advanced schools. As a result, joint facilities have come into being such as the academy/industry complexes, the advanced school/industry research group and the problem-solving laboratories.

The academy/industry complexes make close ties between research and production possible. Current development tasks and long-term research strategies are discussed jointly, and research and implementation problems are solved quickly at a high level. Scientific achievements at the Academy/Industry Complex for Medicines thus led in 1984 to the introduction of 35 new and improved medicines.

In the Advanced School/Industry Research Group for Process Engineering and the problem-solving laboratories at the "Carl Schorlemmer" Technical Advanced School in Leuna-Merseburg, special types of research cooperation were found which improve the universal application of research from the basics to the technology and on to production itself through even closer and better organized interdisciplinary cooperation between the advanced school and industry. In order to maintain the material and technical base, the combines plan and make the necessary basic resources available depending on topic area, and perform maintenance work using the workshop capacity available at the advanced school. The planned cadre exchange program between the chemical combines and the advanced school in Halle provides for the training of industrial cadres and conversely paves the way for employing young scientists from the advanced school in management positions in R&D within the combines. Since 1981 about 20 industrial cadres have completed their scientific training each year at the Leuna-Merseburg Advanced School.

#### Joint Youth Facility

The results which can be achieved through the initiative of young scientists and young researcher collectives is probably shown most clearly by the daily advances made in the use of lignite high temperature coke in place of anthracite coke in the production of carbide. Of particular note in this regard is the joint youth facility of the sectors, coal and energy, construction, advanced school affairs and the chemical industry, which has been in existence for five years.

Close scientific cooperation with the Soviet Union and the other socialist nations remains a crucial factor in increasing the tempo of the scientific and technical revolution and the dynamic development of productive forces. Cooperation with the USSR in particular ensures the development and implementation of new processes and technologies within the scope of intensifying entire production areas in both countries.

Some persuasive examples are the agreements at the government and ministerial level concerning fibrous and polyurethane materials which exist for a total of 21 such agreements on research cooperation within the chemical industries of both countries [as published]. Thus the establishment of a high level of modern, high-performance polyurethane chemistry has been pursued for the past few years in both nations. In the case of fibers both countries were able to increase production capacity and effectiveness, as well as product quality, reduce material consumption and improve processing parameters.

12552

CSO: 2302/107

GERMAN DEMOCRATIC REPUBLIC

BRIEFS

**LARGEST GDR OXYGEN PLANT**--A large-scale plant for the production of high-purity oxygen and nitrogen was now turned over from the construction and outfitting collectives to the Brandenburg works of the VEB Technical Gases Leipzig. With a daily output of 100 metric tons oxygen and 35 metric tons nitrogen their capacity is ten times that of all other plants of the factory combined. It is thus the largest plant in the GDR for the production of liquid oxygen and nitrogen with temperatures lower than minus 180 degrees. Micro-electronic plants, the steel works in Hennigsdorf and Brandenburg, hospitals, animal breeding operations, and numerous others are users of the liquid oxygen and nitrogen. Due to the high degree of automation of the new plant the production is increased considerably with approximately the same number of workers. The operating personnel has resolved in a contest to even surpass the preset output parameters of the builders of the chemical plant. Since the first of three plants of this type started operations in the last year, the construction workers, the builders of the chemical plant and the workers of the VEB Technical Gases have committed themselves in honor of the 11th party convention of the SED to start operating the third facility of this kind in 1986 two months ahead of time. [Text] [East Berlin NEUES DEUTSCHLAND in German 9 Jul 85 p 2] 12693

**FREELY PROGRAMMABLE INDUSTRIAL ROBOT**--The PHM 41 is a freely programmable, process-flexible industrial robot with a maximum of 6 degrees of freedoms. It is principally being used in assembly and feed operations (photo 1) and is controlled via a microcomputer K 1520 which is supplemented by assembly units specifically designed for robots [1]. The robot control can be coupled with a robot-specific periphery through 64 I/O lines each. These periphery signals can be used during command-servicing as simple sensor signals, e.g. for the stacking of workpieces or as digital limit selectors in balancing processes. The user has at his disposal eight integral registers (15 bits and signs each), as well as eight Boolean registers (8 bits each). The user program is generated through an interactive programming system comprising the functions of program generation (editing) and program service (interpretation) optionally in single-step or continuous operation, as well as the teach-in mode for defining of positions. This system has the following advantages:

- Simple command testing by the possibility of an immediate servicing of an edited command
- The possibility of testing programs or parts of them in a one-step operation

- The possibility of interrupting running programs for correction, with the possibility of an immediate restart of the program
- The possibility of inserting or deleting commands in a finished program
- The possibility of correcting individual parameters of a user command within a finished source-language program, including the redefining (teaching) of positions. [Excerpts] [East Berlin FEINGERAETETECHNIK in German Vol 34 No 4, 1985 p 163] 12693

IMAGE PROCESSING ROBOT SENSORS--If the workpieces cannot be placed in a fixed spot with the required precision, the robot has to be provided with a system capable of recognizing the position (location and direction) of the workpiece and to calculate therefrom the location to be headed for. When grippers are used, this can be accomplished with power and touch sensors which are able to "feel" the parts. In many cases, however, (e.g. during contacting, the so-called "bonding" of the chips during the assembly of microelectronic elements), only an optical detection of the location is possible. For this purpose, image recognition systems are necessary which record the picture as a multitude of gray values associated with the individual image points (if color recognition is necessary, also as red, yellow, or blue values). They store this pattern and calculate the required parameters, such as the location of a structure, an edge, its oblique position, distances to other structures etc. In that way the robot is controlled in the necessary manner. Since 1976 semi-conductor sensors (so-called CCV sensors) are available instead of the (vacuum) pick-up tube of industrial television, which have the advantage that a multitude (256, 1024, 2048) of extremely small photoelectric receivers (13x13 micrometers) are arranged with great precision side by side as a line or in form of a (surface) matrix. The photo-signals of the individual receivers are then read out rapidly one after the other. These receivers make it possible to determine differences in gray values with much greater accuracy than is the case with tubes. As a result, very accurate determinations of locations can be made. Even without enlargement it is feasible with the aid of a computer to determine with these sensors the location of an edge within about 0.2 micrometers. Since 1983 the VEB Studiotechnik Berlin has offered a number of such "artificial eyes" for automation engineering. It will be possible in the future to solve every decision task (error detection and sorting, positioning etc.) by means of such image processing systems in a much shorter time than by using people. [Excerpts] [Magdeburg VOLKSSTIMME in German 5 Jul 85 p 2] 12693

PCB TESTING COMPUTER DEVELOPED--A Fourier measuring device was developed in cooperation between the VEB Measurement Electronics Berlin and the Center for Scientific Instrument Design of the East Berlin Academy of Sciences. This microelectronic measuring device permits working on additional tasks of digital measurement systems. The device is scheduled for introduction at the Leipzig Spring Fair. The VEB Measurement Electronics has delivered to date over 100 new measuring computers to industry. The control and display unit is based on the microcomputer K 1520. The new measuring computer is fitted with a screen and takes over hundreds of measurements which had to be performed previously by hand. The computer can be coupled with peripheral equipment, such as magnetic tape cassette recorders and printers. In the East Berlin plant mentioned above, it is being used, for instance, for the testing of printed circuit boards. [Text] [Bonn IWE WIRTSCHAFTSDIENST in German Vol 26 No 11, 22 Mar 85 p 5] 12693

2 December 1985

SMALL COMPUTER PRODUCTION TO RISE--The computer age has also begun in the GDR. As Prof Dr Rudolf Reichel of the East Berlin College of Economics reported in a talk with students at the transmitter "Radio GDR," a large number of computers have already been used last year in plants and administrative functions. This, of course, is only the beginning. However, work place and office computers will be introduced in the GDR "shortly at a very large scale." The statements of Prof Reichel reveal that home computers too are being manufactured in large numbers. According to the East Berlin scientist, however, the latter are at present delivered "exclusively to educational institutions." A student criticized in the course of the talk that the GDR youth had "still very little" access to the computer, beginning with teleplays and the chess computer to the computer. It was difficult to get access to things. [Text] [Bonn IWE WIRTSCHAFTSDIENST in German Vol 26 No 14, 15 Apt 85 p 1] 12693

CSO: 2302/102

HUNGARY

PLIGHT OF ACADEMY NATURAL SCIENCES RESEARCH INSTITUTES

Budapest MAGYAR TUDOMANY in Hungarian No 12, 85 pp 980-986

[Article by Kalman Pannonhalmi: "Survey of the Research Institutes of the MTA"]

[Text] In the first months of 1984 the leadership of the academy surveyed the situation of the institutes belonging to the Natural Science Division of the MTA [Hungarian Academy of Sciences]. The purpose of the visits to the institutions was to generate a comprehensive view of the present situation of the research facilities and their ability to fulfill their tasks, with special attention being paid to the achievement level of their staff, and to the financial and technical resources and other factors of major influence on their work. The discussions were conducted with the participation of the director-in-chief, director, deputy science director, financial managers, party, union and KISZ [Hungarian Communist Youth League] secretaries. The principal questions to be discussed were mailed to the institutions prior to the discussions. The emphasis of the discussions was different in each case, depending on the institute. The leaders of the institutions were all well prepared. The questions were discussed at most sites with the scientific directors and almost everywhere were the subject of an executive council meeting. Naturally, there were differing opinions regarding some important topics. This report does not detail all the topics discussed but will only seek to point out those items which are of general validity.

Intellectual Base Characterization

The success of research work under a set of imposed conditions depends primarily on the caliber and the abilities of the available scientists to do independent creative work. In most of the institutes, around great research scientists schools have developed that in a particular narrow research area are known not only in Hungary but have contributed internationally significant results to the development of science. By contrast, there are several research areas where there are no internationally known schools but which still have significant numbers of internationally recognized researchers. The number of those workers who through their knowledge of their field, preparation, or acquaintance with foreign languages rise above the level of the average researcher, is great. This

group represents the elite without which the institutions could not function. In a number of institutes they account for 40-50 percent of the research staff. This group has a major role in the activity that leads to publications and significant practical results. Internationally significant scientific results can generally not be expected of them.

The quality of the research staff can also be judged from the fact that in the institutes 29 percent of the workers have an advanced scientific degree. (In technical fields the number is higher, in the natural sciences lower. The extremes are 15 and 80 percent). The proportion of individuals with university doctorates is very high. In several fields there is an international recognized research group, among whom the proportion of approximately 30-year olds has gratifyingly increased.

Researchers in certain areas are in brisk demand even by developed countries. More and more receive visiting researcher, visiting professor, stipend or work offers. In recent times the number of offers for leading positions has increased--as directors of laboratories or as scientific directors--especially for biologists but also for physicists and mathematicians. In the majority of such cases the invitation for a position signifies international recognition. In recent times even stipends have been given only to people who have already proven their aptitude for a research career. The part of the research staff that could work more effectively in other areas varies with the institutes. A majority belongs to an age group that will reach retirement in the next few years. The institutions should invest themselves more forefully of their younger coworkers who are less suited for research work, helping them towards other jobs--conceivably in other fields--where they can be more useful to society and to themselves. In any event, this group and these positions represent the reserve from which individual institutions can solve the personnel problems in areas in need of expansion or, conversely, where research activity must be narrowed. By eliminating these positions, salaries in the system can be improved while also improving the unit cost per research worker.

The average age of researchers is 37-40 years and shows progressive increase. The proportion of researchers below 35 is around 30 percent and at only two or three institutions is this proportion 50 percent. The approximately one-third proportion is acceptable but the trend is unfavorable and all signs indicate that the existing conditions do not permit its arresting or reversal.

One priority topic of the discussions was the position of young researchers. Whereas in times past the number of candidates responding to positions offered for beginning research workers was at least twice the number of openings, in recent years the number of candidates does not equal the number of openings. Especially few candidates present themselves among engineers, agricultural specialists and biologists. As a consequence, selection operates hardly, if at all. There are several reasons for this:

-Industrial companies and farm businesses can give at least one thousand forints more a month than the academic institutions, and the economic conditions are also better later on.

-In other jobs many ancillary services, such as securing an apartment and getting social services, are better.

- While the economic conditions and social services are worse in the academic institutions, the requirements are much higher (advanced degrees, knowledge of foreign languages, etc).

In spite of all this, the institutes have found that if a young person chooses a research career, his preparation is better and his knowledge sounder than was the case with a beginner 10 years ago. However, problems with an independent life and with starting a family are larger and, although this is a subjective statement, enthusiasm appears to be less. Few can afford to work at the institute until late in the evening because a significant number of these young researchers need the extra income which can generally be earned only outside the institution and often not even in their field. In the more favorable cases by working in a for-profit cooperative, in less favorable cases by tutoring and translating, or even worse, by janitorial work or other unskilled labor.

The spontaneous mobility of researchers is not significant, with few exceptions it is 2-3 percent per year. Greater mobility can only be observed in recent years among engineers active in research and development in the area of computer technology, especially as relates to the founding of small businesses. The lack of mobility is due to the conditions of research; these are, in spite of their recent deterioration, still better in the institutes than at the universities or at industrial research laboratories.

#### Materials, Equipment

Some of the basic ingredients of successful research work are the availability of instrumentation, finances, and satisfactory amounts of foreign exchange. Conditions have deteriorated rapidly since 1979 and there is a general feeling in the institutes that if the trend continues, in 2-3 years irreversible damage will be done to the quality of the research structure. The greatest concerns are the following:

The reduction of the outlays since 1979 has led to obsolescence of the machine and instrument holdings. The average age of the instruments is nine years, but many are 10-15 years old or even older than 15 years. For example the latest modern electron microscope acquisition necessary for structural work was in 1978.

Regretfully, in the last 7 years, with the exception of the IBM computer, no unique major instruments could be acquired by the institutes of the academy. Characteristically, basic instrumentation is lacking or is in a dilapidated condition. For example, this is the case with gas and liquid chromatographs, ultracentrifuges, and the like. In the newest institute of the academy, the 11-year old Biology Center at Szeged, the net value of the equipment is now below 50 percent of the original. The net value of the equipment at the older institutes such as the Central Physics

Research Institute and the Computer Technology and Automation Research Institute is about 37 percent. There are only 2-3 smaller institutes where the net value of the instrumentation exceeds 50 percent.

Unfortunately, a further deterioration of instrument availability is anticipated. The nominal value of the orders for machines and instruments for the MTA's institutes in 1983 was only 38.3 percent of the budget for the same purpose in 1979. One-third of the natural science and technical research institutes have not been given a budget for new equipment or have received an insignificant one. A notable and increasingly important trouble spot is the lack of computer equipment and the obsolete nature of the existing machines. The central computers of the academy do not satisfy in any respect the increasing demands placed on them, and there is a serious shortage of smaller capacity machines such as the personal computers which are regarded as basic tools these days.

Even the use of the existing instrumentation is hindered by the meager foreign exchange budget necessary for their operation and repair. This has always been a major problem but the budget sank deep below the critical level in 1982-83, from 50 million forints in 1981 to 32 million forints. The situation was further aggravated by the import restrictions of the last few years which prevented the use of even these low budgets. It is expected that the situation will be improved in 1984 due to the somewhat increased--38 million forints--budget and the decision giving the first secretary of the academy the power to restructure the foreign exchange budget for the purchase of machines and instrumentation. In my opinion, these steps will bring only minor improvements and will not solve the problems. The gamut of materials and parts, including chemicals, available from supply sources for Hungarian currency has undergone a marked contraction, and the rise in prices has continued.

To characterize the past few years in a few words, the costs of research have increased rapidly while the state budgetary support has stagnated. The income of the institutes from the state budget is around 600 million forints per year since 1981. In order to compensate for this situation it was necessary to increase income-producing contractual work. Between 1981 and 1983 the income from this source was 1300-1500 million forints. This approach has led to a decrease of the proportion of basic research, but the institutes had no other course but to increase profitable contractual work. Only so could the severe decrease in the state budget and the financing of direct research costs--which even at this current level is about a third of the optimal--be answered. This approach has also allowed the maintenance, and in some instances the increase of salaries. Today direct research costs are in the range of 250-500 thousand forints per researcher per year, instead of the optimal 500-1500 range.

In the institutes which conduct a high volume of contractual work a grave problem was caused by the absence of a revolving fund. The revolving fund tied up a significant fraction of the monies available for institutional development from the profit of contractual work, and this in turn lessened the institutes' investment opportunities and adversely affected the

financing of the research initiated by them. Only in very recent times could this problem be somewhat alleviated with the aid of the government.

The financial problems of acquiring foreign technical literature sources, primarily journals, have increased. In 1982 the foreign exchange for journals was reduced by 20 percent upon central directive. True, later this was corrected to a certain extent, but the decrease and the higher subscription fees have resulted in the discontinuation of many important journals. The yearly price increases for journals are in the 25-40 percent range. In 1985 we may expect a 30-40 percent rise in the subscription rate in the natural sciences. This problem cannot be solved by stopping subscriptions to new journals. The foreign exchange budget must be increased.

#### Measures to Prevent the Deterioration of Conditions

The continuous and increasingly rapid deterioration of the conditions of research require decisions at the institutional, academic, and governmental levels so that its consequences do not become irreversible. In order to moderate the deterioration of the conditions of research, the tasks and measures perceived by the institutions as being the most pressing need to be pointed out.

-The institutes estimate that in the next few years one cannot expect significantly increased support from the state budget and that further internal reserves must be uncovered. One very difficult part of this is the selection of research topics not in a formal way, but on a one by one basis. If conditions allow, the number of researchers should be decreased by the course of natural personnel movements. Where it is indicated, personnel should be relocated within an institute.

-The institutes also plan to increase their for-profit contractual activity, although many external factors influence this.

-The MTA must devote the financial resources at its disposal, such as the central research fund, investment instruments, and various foreign exchange budgets in an even more concentrated fashion to the most promising areas of basic research.

-The creation of special and regional laboratories with major instrumentation must be examined. This can be done cooperatively between two or more agencies, helping to concentrate financial power and to improve the accessibility and utilization of major instruments.

-A well-founded desire is to create a fund that would be awarded competitively according to rigorous criteria, to halt the deterioration in the proportion of work devoted to basic research. Since the time of the interchange with the staff of the institutes significant steps have been taken. In August 1984 a grant solicitation appeared which offered 200 million forints from a centralized fund for the support of basic research.

-Research needs foreign exchange. The means at our disposal can only be utilized if a suitable budget is established for a variety of purposes-- journals, machines-instruments, materials-parts, and travel. In the next few years these budgets must be increased significantly and the restructuring of funds should be permitted between certain limits.

-As in previous years it should again be permitted to transfer foreign exchange funds from one year to another, because orders placed for imported articles have long delivery times caused by natural and artificial barriers. Moves should be made to eliminate artificial barriers against the imports from capitalist countries. The granting of import licenses should be simplified.

#### Ratio of Basic to Applied Research

This terminology has unchained a debate in many institutes. Some do not agree with this differentiation and prefer to use the term "long range research" instead of "basic research." In spite of the debate on terminology, the opinion is wide-spread that the proportion of basic research has been declining for a considerable time. Its causes, cited at random, are:

-With the increase of economic problems social demands on research have increased and have changed in orientation. Research products that would bring quick economic benefits and would help solve current economic problems are expected. These demands have achieved concrete form in national and other major research and development programs in which the academic institutes have been participating.

-The contracts with outside organizations and companies have increased, and this activity is aimed almost completely at solving concrete, short-term problems.

-Social and financial rewards are given primarily for results bringing economic gains. A substantial difference can be demonstrated between the income of an internationally recognized, highly qualified scientist doing basic research and an engineer of average ability working in research and development, in favor of the latter.

-The institutes' hands are tied due to the stagnating budget and the rise in costs. Contract work, a spinoff of basic research, is an economic necessity. It is the source of the funds which are needed to supplement the support for the projects of the academy and for locally-initiated projects which also receive financing from the state. Contract work also pays for research trips abroad and for social services. The very low salaries of the research workers can also be supplemented from this source with premiums of various size, depending on the institution.

-Economic factors promote the signing of contracts with companies and not with the state directly, because of larger financial gain. It must be mentioned that up to 1981 there was no profit at all to be made from state commissions. It should also be remembered that in some institutes,

within the framework of contractual work, development and production have been favored more than is desirable. This is the reason that there are few if any cooperatives that are willing to undertake the manufacture of a few or a few dozen pieces of apparatus, except for those that have been recently established. These tasks have been delegated to the institutes and have occupied researchers, utilizing the research infrastructure to an unnecessarily great extent.

#### International Scientific Relations

International scientific cooperation--common and coordinated research, participation in scientific meetings and personal contacts--is an equally important aspect of research. Certain scientific problems such as those in nuclear and particle physics are routinely researched in international cooperation because of the very expensive nature of the equipment needed. All the institutes have extensive international contacts which they regard as essential in planning their work. Most of the contacts are established through the partner academies, science agencies, and by agreements made between states.

Two-partner relationships, with socialist and capitalist groups are looked upon favorably by everyone. Multilateral agreements on the other hand are, by general opinion, not very effective. Whereas the majority of bilateral projects is mutually designed research (cooperative measurements and their evaluation, common publications and talks given at meetings, exchange of materials and instruments for research, shorter or longer support for working conditions), the multinational agreements are limited to the exchange of information and formal discussions. Exceptions to this statement are the KGST program in biophysics, the intergovernmental multilateral agreement about research in reactor physics, or work at such major research sites as the International Electron Microscopy Laboratory in Halle, the International Banach Institute for Advanced Study in Mathematics in Warsaw and the International Heat and Materials Transfer Institute in Minsk--with all of which our institutes cooperate fruitfully.

With regard to the relationships with capitalist countries, cooperative projects have increased in number. The cooperative relationship with the DFG [German Research Foundation] in the German Federal Republic and, in spite of certain financial problems, with the National Science Foundation in the United States, is exceptionally successful. On the basis of the positive experiences the idea has surfaced that every aspect of the cooperative projects should be expanded. In the last few years, however, the former willingness of the capitalist partners for cooperation has decreased, especially in the domain of microelectronics and computer science.

Leaves of absence for study are possible mainly by way of academy agreements, by accepting work, by receiving an invitation with a stipend, or through participation in the competition established by the State Scholarship Council. Proportionately and in absolute numbers very few such leaves are taken to socialist countries. The reason for this is that no housing

can be found and very few people are willing to be away for a long time from their family. It should also be kept in mind that these trips are not rewarding from the financial point of view.

An uncertain area of international cooperation is the scarcity of foreign exchange funds for travel to meetings. Frequently no permission can be granted to attend even the more important international meetings or it may be that officers of international organizations are unable to travel. This happens in spite of the fact that our absence from international scientific activity can lead to the isolation of our national research programs. A number of institutes have indicated that foreign exchange funds even to socialist countries are insufficient for some important trips.

It seems that keeping international cooperation at an acceptable level will require an increase in the foreign exchange funds. Simultaneously, an opportunity must be created to get more capitalist and socialist foreign exchange from institutional funds. This should not be charged entirely against the institute's share of the funds but should be regarded as part of normal expenses.

A new feature of international cooperation is that in the past one or two years large Western companies have shown interest in setting up common laboratories, they have given research commissions, or offered to do so in the field of biology and plant breeding. This is due to the strong Hungarian scientific record in these fields, which enjoy an international reputation. The 1983 directive regarding the acceptance of work abroad had a favorable response from researchers.

#### Objective, Subjective Factors

In the natural science and technical science institutes of the academy the atmosphere is generally good, well balanced, and free of extremes. It can be sensed, however, that unless a significant change in the right direction is initiated, the highly qualified group that has developed over decades will lose its enthusiasm. Without favorable changes, precisely that part of researchers will become interested in working abroad which could make the greatest contribution to research in Hungary.

Without pretence of completeness, I will mention some objective and some subjective factors that influence the morale of the group:

-The decrease in the esteem accorded scientific research and the moral and financial rewards researchers receive. This is evident in many ways; for example, by the exalted praise for research results producing quick economic gains and the disinterest shown in results from basic research; the stagnation or decline of research budgets from state sources; and the fact that government still treats research as a money-consuming activity which only uses up state funds. In reality, research often produces economically valuable results even when no monetary value can be put on them.

-The value scale of the academy does not seem to be sufficiently clear. What does the academy value more, basic research results that receive international recognition or such applied research and development activities which can be explained readily to the public?

-The prestige of a career in research has been sharply reduced. This becomes obvious when comparing the salaries of research and non-research workers.

-The results of applied research appear in the production statistics of companies but frequently no recognition is given to the fact that the institutes' research has played a part in their economic performance.

The directors of the institutes are optimistic in spite of the above. They are convinced that there is a need for the work of the institutes and that society cannot do without them.

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HUNGARY

PROSPECTS OF MAKING, BUYING, USING ROBOTS VIEWED

Budapest FIGYELO in Hungarian No 39, 27 Sep 85 p 6

[Article by Gitta Takacs: "Do We Work Like Slaves or Use Robots?"]

[Text] It is not by chance that everywhere in the world they are keeping track of how many robots are being made and used in which countries. Where they can manufacture robots in series they have modern technology, appropriate precision engineering, electronics and software expertise and tools. Where they can work with robots they have a high level of technical and manufacturing culture, the production processes are well ordered and the support industry produces good quality products. From these figures--although they must be treated with more than a few reservations due to differing definitions of robots--one can draw conclusions pertaining to all the industry of a country and the technical level thereof.

A robot is a "peak product", the use of which also represents an industrial organizing force, because the fact that a robot requires a continued supply of parts of high precision and perfect quality "reacts" on the supply industry, on the preceding work phases and services, on the organization of procedures into a system, etc. As an indicator or "outside expert" it immediately signals the errors, the lack of organization and the irregularities, it "relates badly" to an obsolete technological environment and immediately points out the existing problems and troubles regardless of the use being made of it.

Our country can still brag of only modest achievements in both the manufacture and use of robots.

Manufacturing Beginnings

It is an unfortunate fact that at present not one domestic enterprise manufacturing robots or intending to do so has the technical equipment, manufacturing technology or parts and service background needed for series manufacture of robots and their subassemblies of the kind of high quality the developed industrial countries are accustomed to, with the precision and reliability needed in an industrial environment.

A number of enterprises are dealing with robot development. In general, the starting point was purchase of a capitalist license, the adaptation and

further development of which serve as a basis for manufacture. For example, the Bakony Works is making simple assembly manipulators on the basis of a Bosch license, the Mosonmagyaróvár Metal Fittings Factory is making a manipulator system to serve die-casting machines, the Custom Machine Factory of the Csepel Works has begun manufacture of robots on the basis of a Japanese Daido Steel license and the Rekard Agricultural Machine Manufacturing Enterprise in Győr has purchased an Austrian license.

High precision working of very reliable mechanical and precision engineering parts, the development and manufacture of electronic parts which play a key role, and the robot controls appear as problems of equal magnitude in robot manufacture. Perhaps this is why one expert said that robot manufacture is a "veterinarian's horse" [i.e. one showing all the diseases] for the newly developing technology, "mechatronics," integrating electronics and precision engineering into a system. At present, for the most part, the control unit increases the capitalist import content of robots and so the experts are urging some sort of union or association to develop and manufacture a uniform control which could then be adapted to robots of various types. The OMFB [National Technical Development Committee], which has already taken certain initiatives in the interest of this, is counting on the participation of the EMG [Electronic Measuring Instruments Factory], Vilati, Videoton, the SZTAKI [Computer Technology and Automation Research Institute] and the Budapest Technical University, among others.

For the time being large series manufacture--one thousand--is being done only in the Gyöngyös factory of the Microelectronics Enterprise for a very special applications area, robots to move color television picture tubes, primarily for Soviet export. Elsewhere they are still at the prototype level, or have started with a series of only ten or so units, for the domestic and socialist market.

But what must be especially noted is that it is not enough only to manufacture and sell robots, the customer also needs the applications design, installation and engineering work. (Let us think only of the computer technology and organization link--how many fiascos were caused by neglect or slipshod organizational work!

The model assortment and number of units of the domestic manufacturing base are small also. There continues to be a need for import to satisfy the demand. Because of the narrow foreign exchange framework--and in part due to the well known capitalist restrictions--the possibility of obtaining good quality capitalist-made robots with a good maintenance background and applications assistance is very limited. The delivery capability of the robot manufacturers of socialist countries is unusually small and the development of their systems is not always satisfactory either.

At the end of 1983 the statistics indicated there were 40 robots in use in our country; at present about 70 are in operation, some of them work continually in manufacturing systems, and a good number of them are used for development or as reference systems for development.

## Applications Panorama

A separate paragraph should be devoted to a review of the experiences of a few experts with about 20 domestic robot applications, done on an OMFB commission. A written evaluation of the survey has not yet been made public; we received a "status report" from Dr Miklos Hajnal, an assistant professor at the Budapest Technical University:

The situation with the robot applications is rather mixed.

In general it can be said that only individual robots have been installed and put into operation, as "islands." The "loneliness" of the robots may be one cause of the fact that almost everywhere the work of the robot has been adjusted to a given work organization or process and not vice versa; the environment has not been transformed for the sake of the robot. But one of the advantages of using a robot, the profit of a robot, can be truly felt if robots are integrated into a system, if they appear as a "group." The development of the supplementary, service equipment (turning tables, a system to store and receive parts) and fitting the robot to the technical equipment in its environment--not always modern--have caused problems in many places.

The utilization of the robots can be called bad for the most part. There are places where they are worked one or two hours a day, others where they are worked one or two shifts. There are places where the third shift is needed to move the material to the robot and remove the finished products. It is a rare example where the equipment works 24 hours a day. One such is the Raba Car and Machine Factory in Győr, where they are using a feeding-moving robot and a Swedish ASEA robot to weld rear-axle assemblies, integrated into a modern manufacturing line amidst CNC machines and manipulators. They have succeeded in ensuring work pieces of the kind of quality demanded by a robot with the precision and accuracy of form faithfulness indicated by the preliminary design.

Everywhere the quality of the products improved significantly when the robots were put into operation; for example, the strength and elegance of the welds improved and manufacturing waste was practically eliminated.

The human factors were studied also. It happened when selecting robot operators that they considered not who was most suitable but rather who could best be done without; for example, they assigned women about to be retired to the robots in some places while elsewhere they bid for an incentive which would make the robot operator a little envied. In general no sharp distinction was made between operating and programming the robots, which was justified by the fact that if they got work pieces which did not meet the original plan in regard to precision or form then the operator could solve the problem with a little modification of the program. (This would not be needed for precise parts.)

The impressions gathered about the behavior of the shop leaders are interesting. In general they relate to the robots in an ambivalent way. They are happy about them because the quality and precision improve and waste is eliminated, but they also represent an extra burden for them and they could

carry out their tasks without them too. The survey also studied what impetus might be given to the robotics cause by the "technical fanatics"--where there were any.

To sum up, the final conclusion is not surprising: Robots work efficiently where the work done by humans is also well organized. The robot is worth a lot only if a suitable place of work and work environment are organized around them and if the thinking is not in terms of individual machines but rather in terms of manufacturing cells--at least after the experimental, testing, learning phase.

#### Who Is Competing For What?

In March 1983 the OMFB and the Ministry of Industry announced a competition to further domestic robot applications. In it they promised significant financial support, but only for acquisition of robots which did not come from the capitalist market. This non-repayable support covers about 40 percent of the price of the system. (A 50 percent contribution figured in the original thinking but, as it turned out, the enterprises generally underestimated the costs, primarily for the supplementary, auxiliary equipment.)

Forty-three enterprises applied for this competition, for the installation of a total of 158 robots--including manipulators. The "robot jury" finally judged the need of 33 enterprises for 81 robots to be technically and economically well founded. About 100 million forints in support was granted for this. A decision was made in regard to 9 machine tool serving robots, 6 painting robots, 3 welding robots, 8 robots to serve die-casting machines, 16 to serve stamping machines and about 40 simpler and cheaper (0.5-1 million forints) robots, which were to be put to use last year and this.

#### Prognosis

In its robot plan the Ministry of Industry predicted the robot needs of domestic industry up to 1995 as follows: It is expected that 1,000-1,500 robots will be placed in operation; of these, for example, 100-150 will be for welding, 60-70 for painting and surface preparation, 150-200 to serve machine tools, 100-180 for hot plant, foundry purposes, 150-200 for use by the synthetics industry; the plan is to put 600 robots into operation by 1990, and to do this the enterprises can count on one-time, non-repayable technical development support from central sources.

While it is a virtually impossible task to measure in figures the payoff, the time it takes for robots to pay for themselves, at the enterprise level, because of the distorted costs ratios for manpower and tools of production among other things, the conception does justify the utility and necessity of robots at the national economic level with preliminary calculations. According to these, with the 1,500 robots expected to be put into operation after 10 years, the material savings (for example of paint, enamel and welding metal) come to 225 million forints per year at today's prices; the personnel saving (2.5 persons per robot) comes to about 1.5 billion forints; and 75 million forints will come from quality improvement and waste reduction. The repayment time is estimated at 3.26 years. Naturally one should also mention the

unquantifiable--but certainly all the more significant--effects of better organization, social policy and increased flexibility.

The use of robots and the automation of production processes in general are not a fashion for an enterprise wishing to remain in competition on the world market; rather they are a necessity, a path that must be taken. But it is characteristic of the difficult situation that where robots would appear as a welcome new force, because the earlier technological development of a few years ago provides a receptive environment, the assets burdens of the enterprises are so great that they must be very careful about acquiring new, valuable fixed assets. And where the tools of production are obsolete, even the elementary conditions for using robots are missing. There is a need for preferential credit and tax policies and an elimination of the high duty--50 percent. This is the punishment for those who sacrifice for modern imported technology!

The period of the Seventh 5-Year Plan will certainly be a crucial few years in the spread of the use of robots as well. Effectiveness and success depend on, among other things, whether we succeed in spreading in a broad sphere the model systems developed and tested in a few spots, creating mass acceptance.

Finally, a news item: The Hungarian Robot Technology Society held its founding meeting on 4 September--as the closing accord of the Mechatroninfo '85 conference. Thus we have already caught up with the most developed countries; ours is the somethingteenth such federation in the world.

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HUNGARY

ROBOT ENGINEERING COMPANY

Budapest FIGYELO in Hungarian No 39, 27 Sep 85 p 6

[Article by "--as": "An Engineering Company"]

[Text] The Rekard Agricultural Machine Manufacturing Enterprise in Gyor was struggling with production problems due to the lack of welding capacity. For this reason, in 1981, it purchased a two-head Austrian welding robot to manufacture parts for combines. Thus began its contact with robots and with the Austrian IGM firm, and not much later Rekard was manufacturing parts and turntables for the Austrian robots. Their sales receipts from this have increased from a few hundred thousand schillings in 1982 to more than 10 million in 1984.

The sequel: In 1985 Rekard--with central support--purchased the license for the arc-welding robot and the right to manufacture it and sell it in East Europe, and started a cooperation in which the Austrian firm will provide, at a plus 10-percent balance favorable to us, the drive, control and microelectronic elements in exchange for guaranteed good mechanical robot subassemblies manufactured by Rekard.

A contract for the manufacture of five robots was signed this year. They plan a series of 50 units for 1990 with a continual increase in manufacture. Since Rekard manufactures primarily drive mechanisms and universal joint shafts its developmental and design capacity is relatively small. The robot will be only one product among many, providing only a few percent of their sales receipts of 1.4 billion per year.

For this reason Rekard initiated the creation of an independent deposit association for the work connected with putting the robots into operation, customer service and applications consulting--which is judged absolutely necessary for the sale of robots--and for surveying and organizing domestic marketing-manufacturing capacity for various subassemblies and for the further development of the license purchased--into painting and flame cutting robots. The Roboplan company was formed by the end of July, very quickly compared to our domestic "habits," with membership by two small banks, the Agricultural Innovation Association and the Construction Industry Innovation Fund, in addition to Rekard, with a base capital of 10 million forints. The people in Gyor provided half of this and the banks provided the other half.

"Robot manufacture is certainly of great significance in the life of Rekard, but it will not be a chief factor in sales receipts. It will be for the Roboplan company," said Ferenc Szegedi, who at present is still chief of the Budapest branch office of Rekard but who will be director of the company after it is registered as a firm. "In recent years Rekard has created a technological level for the manufacture of its products which gave us an entry to robot manufacture. But almost more important than the sales receipts coming from the robots, in my opinion, is the fact that robot manufacture will have a stimulating effect on the manufacture of our other products and on their quality level, plus our technology will develop further.

"When it was mentioned that we would like to manufacture robots, we felt a certain resistance or amazement, as if they didn't take us seriously enough as an agricultural machine enterprise. I must say that this Austrian-Hungarian cooperation did not come into being only as a result of the robot idea, but also because Rekard wanted to sell parts for foreign exchange, so finally the market put together this cooperation.

"I believe that the few robots to be manufactured by us cannot be significant in the international consignments; we intend them primarily for domestic use. It would be good if there were a uniform control unit of Hungarian manufacture as soon as possible, because with that our dependence on possible trade restriction measures might decrease significantly."

There is a contract relationship between Roboplan and Rekard, but the company is open. It could undertake installation and development work for robots manufactured by others, not only Rekard.

Gyula Ujhelyi, a deputy department chief in the Construction Industry Innovation Fund, said: "Roboplan is the first association the fund has joined. It could be started with small capital and we hope for a good return from it. If concrete orders, adaptations or developmental work will materialize we will continually provide funds and even undertake to lease the finished robots and auxiliary equipment, counting on getting the construction industry enterprises, for example, interested in welding robots.

"Roboplan cannot begin to really work yet. We have been waiting to be registered since 4 July. Workers cannot be hired by Rekard until that happens, neither can we start acquisition of developmental tools or computers. So we can count on a profit only in the future."

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HUNGARY

VAMOS VIEWS NEEDS FOR ROBOT PRODUCTION

Budapest FIGYELO in Hungarian No 39, 27 Sep 85 p 7

[Interview with Tibor Vamos, director of the Computer Technology and Automation Research Institute, by G. T.: "Birth of the Model T Robot"]

[Text] There is hardly any economic, scientific or political forum today where it is not noted that a technological change of epoch is taking place in the world and that our homeland is threatened by the danger not of missing a developmental phase but rather of missing an epoch. We asked Academician Tibor Vamos, director of the SZTAKI [Computer Technology and Automation Research Institute], about the domestic system of conditions for the new techniques and technologies--especially the use of robots--i.e. about the economic, technical and educational background for these new techniques and technologies.

[Question] There are more robots working in a single smaller Japanese or American enterprise than in all of Hungary.... The developmental ideas of the Ministry of Industry speak of putting 600 robots into operation by 1990 and about 1,500 by 1996. And reading these rather modest numbers a person thinks: Is this plan realistic in view of the level of the domestic working process?

[Answer] Numbers of robots should not be planned. Such prescriptions are consequences of the old style of mechanistic planning. Looking back after 2-3 years at the estimates appearing in the world press it turns out that everything has happened differently. One cannot say what volume of a product--the robot also is a product--will be needed in 1990 or the year 2000, God only knows. Robot applications depend on very many factors, for example, on the import possibilities, on domestic manufacturing possibilities, on price factors, etc. While robotization was proclaimed throughout the world a decade ago it appears from the international figures for robots that they are negligible in comparison to the number of employees in industry and insignificant compared to the other machine and technology investments. The forecasts pertaining to the spread of computer technology were similarly childish in their time. No one predicted the boom in mini, supermini and personal computers or the cycle changes in the markets for these products.

A robot is the product of a relatively complex machine industry; where such a machine industry exists robots can be produced. In any case, this technological level can be called only moderate in Hungary. The newest robots

operate with a precision of a tenth of a millimeter or better, with great speed and acceleration, with extraordinarily precise adjustment characteristic curves, free of vibration. A robot operating with little precision and mediocre reliability could be made in any shop; we made such a robot 10 years ago in the SZTAKI for experiments, but it was not an industrial product.

I am afraid that the design strength in Hungary today is not sufficient to make one like that. It is a condition that it be done by a very precise, very good factory--like the Machine Tool Factory in Esztergom for example--and of course a good license is needed for the design. The other condition is the price. Large technological robots still cost many tens of thousands of dollars, even a hundred thousand dollars. Operating these in Hungary could pay off only in very rare cases. There will be a breakthrough point in robot technology, whether in America or Japan, where you get a robot like the Model T Ford, with which mass production of automobiles began. A robot is no more complex a tool than a modern automobile, and in time there will be no need for it to cost more. Of course, to do this they must be manufactured in very large numbers and with a high level technology. If there is such a breakthrough it will appear in Hungary also, a few years later, just as it happened in the case of personal computers.

Whether there will be many or few robots here depends decisively on when this technical breakthrough takes place in the leading industrial states of the world. It would be good to prepare for this. This is why we have started research on robot applications and robot intelligence at the SZTAKI.

It is an open question where we should buy the robots. It would be good to buy them from the capitalist market because one could get good quality robots there with a maintenance background and applications know-how, but we do not have the money for it. And the robots of the socialist countries struggle with the well known technological difficulties.

Partial successes could be achieved in Hungary too with ad hoc attempts. But again there is an open question. Since the flexibility of domestic industry is quite limited, are we capable of reaching the threshold of mass production at which manufacture would pay? We could hardly export such equipment, especially to the markets of the industrially developed countries. There is still socialist export, and this might make it possible to reach the threshold of cost-effectiveness, but here the capitalist import content of development and manufacture would cause a problem.

The country must prepare in general for robotization, for robot technology. Basically a robot does not require different controls than a numeric machine tool.

[Question] In connection with the controls, can one feel a certain tension in domestic robot manufacturing aspirations between those who make the mechanical parts and those dealing with controls, with electronics?

[Answer] There is little tension in our area, indeed there is more and more communication. There are more and more people who are interested in both trends in some way. Obviously there are such tensions in the factory strata.

These are caused by objective circumstances. For example, if two somewhat unreliable units must be combined in one piece of equipment then everyone blames the other. For a long time the trouble with Hungarian controls was that although they were at the international level technically, in their theoretical content, their reliability was not satisfactory. Four or five years ago the Japanese designed machine tool controls for an average time of 4 years between two failures, practically their entire lifetime. This is the requirement today.

The western customer did not trust the Hungarian controls, either, because maintenance and follow-up were not guaranteed. Our control technology is not bad. The trouble is that the developmental forces are scattered. We have not developed conditions which would force integration. Even Vilati and the EMG [Electronic Measurement Instruments Factory] have taken different paths.

[Question] A number of international conferences have been held in the recent past on the theme of mechatronics, robots and computerized production control. A number of people participating in these emphasized that Hungary has outstanding theoretical achievements, but practice lags far behind the international level. Do we really have such outstanding achievements? And are these also scattered?

[Answer] There really is a very good Hungarian school. For example, this year Jozsef Hatvany, who works at the SZTAKI, was elected a member of the American technical academy, which is no small thing. And among the winners of the state prize this year I might mention Matyas Horvath, a professor at the Budapest Technical University, or Laszlo Nemes from the SZTAKI, and a very good group around them, who have a place even on the international stage. Vilati has great traditions in the development of controls, under the leadership of Otto Banhegyi. We really do have good forces.

But we have no money, there are market difficulties, and the most serious problem to be solved is that the economic environment should be such that it would encourage cooperation. The facts show that our present economic environment encourages isolation. A large-scale concentration is taking place throughout the world--do not confuse this with centralization!--and this means strong cooperation and capital concentration. This is not happening here. Wherever we look the capital is being scattered, the investments everywhere are smaller than the critical volume, because no one has enough strength alone and they do not see that only together can they create something. The EMG-Vilati case mentioned is such an example. Economic constraints should have an effect in this direction.

[Question] In your opinion, to what extent do the steps in the further development of the economic reform encourage technical renewal, how do they contribute to a more vigorous unfolding of entrepreneurial and cooperative readiness?

[Answer] Taking over, introducing and developing new technologies is not an area for small enterprises but rather an area for large industry and large capital concentrations. So the reform must encourage large industry in this direction, to take a role in introducing the new technologies. We should

encourage cooperation with economic constraints and dispositions that are many times stronger than today, and it is essential that the enterprises be just as interested in solving the long-range tasks as they are in solving the short-range tasks.

[Question] You mentioned that it would be good to prepare for the breakthrough of robots. What role will education have in this? I am not thinking of higher education only but rather of skilled worker training, for example.

[Answer] The requirements are high at every level. A skilled worker must learn concrete things. A person who is at the "top of the pyramid" in development, who participates in management, must master good theoretical foundations, including general culture and a certain disposition. I believe that this pyramid is not well proportioned here. It is not certain that if we forge an elite in sufficient numbers then this will be enough for progress, because it is to be feared that the mass education will "drag them down." The ratio of 3 year and 5 year training is not good; there should be more 3 year training and less 5 year training.... These are only feelings; I am not an expert in this.

The problem, not only in the machine industry but everywhere, is that the quality requirements imposed upon people and which people impose upon themselves have been devaluated. One cannot apply a high-level technology like that needed for robots without being demanding in regard to quality. And there are more and more technologies which require a sterile and precise environment like an operating room for the manufacture of highly complex integrated circuits.

This means environmental conditions which cost money but it also means human conditions. The old industry forged in a hard way and paid the guard which was able to impose quality demands upon itself. Now we have no such strata.

[Question] A book titled "Pszichologika" recently appeared which described in a satirical way the complexities of installing a computerized production control system. Its final conclusion goes like this: "... the computer wants to create order, but we do not like order. So the computer is an enemy!" What the computer represents in the intelligence sphere the robot might represent in production or physical processes. The robot also demands order for itself. In your opinion, do the domestic industrial enterprises and their workers regard the robots as "friends"?

[Answer] Every technological innovation has such effects. There is no technique which does not discipline. The higher the level of the technique the greater its disciplinary requirements for man, and the greater the possibilities for conflict. But this has run through the entire history of technology.

[Question] You once said in a lecture that you attributed a great progressive role to such "tension producing nodes" as, for example, the open cities of China. What are those branches, professional areas or enterprises in our homeland which might play the role of such a "node"?

[Answer] Certainly a few industrial branches where high technology is involved, thus electronics and the high precision machine industry. There are other areas too, such as precision chemistry.

As for enterprises, the Raba Car and Machine Factory in Gyor is such a "node," Videoton is too, to a certain extent, because they place high demands upon themselves. It appears that the necessity for this is being recognized in more and more places in industry.

In agriculture too--the secret of the Babolna and Nadudvar producer cooperatives was new technique and technological discipline.

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HUNGARY

PROBLEMS OF ROBOT PIONEERS

Budapest FIGYELO in Hungarian No 39, 27 Sep 85 p 7

[Article by T.: "On Bumpy Roads"]

[Text] The Ikarus Body and Vehicle Factory is one of the Hungarian enterprises which has been using or trying to use robots for the longest time. They have followed the bumpy road to the end and today have a few robots which work well. And they have paid the tuition.

First they tried out a manipulator from the Eger Precision Fittings Factory to serve a stamping machine, but they found that this machine was too slow for that, the adjustment conditions could not be programmed adequately for the various parts. Then they experimented with an American Unimate hydraulic robot.

In 1981, with the aid of the OMFB [National Technical Development Committee], they purchased a Swedish painting robot which they work only off and on, there are times when it is idle for weeks. The reasons are that the paint is not of suitable quality, the adjustment precision of the moving car is only plus or minus 15 centimeters, the turning system often fails because of the paint particles, etc.

Their ideas included buying two West German stamping machine serving robots, but this miscarried because the experts of the manufacturing firm--after studying the tools and the technical environment of the robot--withdrew their delivery bid.

Learning from the failure of the Swedish painting robot, they did not ask the ESAB firm for a guarantee regarding the parameters of the robots for thin sheet welding but rather asked that they put the robot into operation with all supplementary, auxiliary units and guarantee the quality of the parts to be manufactured. The robot arrived in January 1983, the "running in" lasted one year. This robot works an extended shift and can prepare 25 types of work pieces, resulting in extraordinary quality improvement. If it were to operate 16 hours a day it would satisfy all the needs of the factory. But since the robot operators will not work a night shift some of the parts are still manufactured in the traditional way.

They also have a PUMA robot which the SZTAKI [Computer Technology and Automation Research Institute] used for years for its developmental work and adding to it the results of their research on assembly technology and artificial intelligence (a vision module) developed into a unit suitable for assembly of ceiling lamps of busses. It turned out in the experimental applications that it was essential, for example, for the all of the bulbs to have the same diameter and that even when designing the buses attention must be paid to the fact that robots would participate in the manufacture.

"Despite the difficulties the path of development is the use of robots," said Istvan Lepsenyi, chief of the manufacturing development main department, about the future. "In the recently held robot competition we were promised material support for purchase of point welders."

A robot is not a cheap amusement, it costs 6 or 8 or 10 million forints. Thus far Ikarus has received 16 million forints in central support and has devoted five times this amount from its own resources, from its technical development and investment funds, on robots. The 50-percent duty which burdens the import of modern equipment is unrealistic.

In 1983 the Custom Machine Factory of the Csepel Works bought a license for the hot plant loading robot of the Japanese firm Daido Steel--with Western European sales rights, after several years of discussions, with partially repayable support from the OMFB and the Ministry of Industry. The license purchase was preceded by market research by Technoimpex according to the results of which this hot plant robot, with a load capacity of 30-1,000 kilograms, could play a "gap filling" role on Western European and socialist markets.

Preparation of the first unit began in 1984 and lasted until March of this year, by which time a model system was prepared in the Iron Works of the Csepel Works.

"We not only bought the license from the Japanese but also we could learn that the robot could be a business success only if we sold it built into a system," said deputy director Laszlo Zarai about their plans. "They will pay twice as much for it if we also undertake the work going with installation and adjustment of the system. We must still learn this, however, and we need a domestic environment for this, only after that can we undertake such a thing on the international market."

However, they promise completion of the prototype built with domestic elements only after another 6 months. The manufacturing problems--it appears--are piling up around the control unit. The Custom Machine Factory will make the mechanical parts and Danubia will make the hydraulics. The control unit fell to Vilati, which has good traditions in controls for machine tools.

Otto Banhegyi, a main department chief at Vilati, said: "We undertook it in March of last year and despite the small manufacturing series we are happy to be dealing with the robot controls because we would like to help the people at Csepel and to get experience in robot technology. We have been working on it

for a year and a half and the documentation of the software is not complete yet. Hopefully we will finish it by the middle of next year.

"The biggest problem is caused by acquisition of parts and materials; the average receipt time is one year and although we have already made some of the necessary circuit cards there are parts the ordering of which has not even started for administrative reasons."

The Csepel plans call for manufacture of one or two systems next year and 15 systems in 1987-1988.

The drawn out license discussions and now the manufacturing waiting time made further development necessary, for the obsolescence time in this area is short. In the further development contract signed with the OMFB they set the goal of developing track control instead of the present point control, developing sensors which can do more, and making the robot more intelligent, bringing in workers from the SZTAKI, the Budapest Technical University and other institutes.

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## SILICON SEMICONDUCTOR DEVELOPMENTS

Warsaw POLISH TECHNICAL REVIEW in English No 2-3, 1985 pp 3-4

[Article by Andrzej Bukowski: "New Technologies of Manufacturing Semiconductor Silicon"]

[Text] A number of new technologies for the manufacture of silicon monocrystals have been developed at the Institute of Electronic Materials Technology (ITME). Some of them are presented in this articles.

### Silicon monocrystals with a diameter of 100 mm

This material is prepared by the directional crystallization of silicon contained in molten state in a quartz crucible. The process is known as Czochralski's or the crucible monocrystallization method which is most commonly employed when manufacturing monocrystalline silicon used in the production of large-scale integration MOS integrated circuits (MOS-LSI). Progress in the preparation of silicon monocrystals by Czochralski's method consists in meeting the increasingly higher quality standards (decrease of carbon content, oxygen content control, improvement of structural properties) and in increasing the diameter of the material manufactured.

The Institute's technology of obtaining silicon monocrystals with diameters of 100 mm features the following parameters: diameter  $100 \text{ mm} \pm 0.2$ , crystallographic orientation  $\langle 100 \rangle$ ,  $\langle 111 \rangle$ , monocrystals length 200...1200 mm, rated resistivity values  $0.5 \dots 30 \Omega \cdot \text{cm}$  type "n"  $0.5 \dots 60 \Omega \cdot \text{cm}$ , type "p", deviations from the ordered resistivity - max. 25 % for  $\rho_{\text{max}} 20 \Omega \cdot \text{cm}$ , max 35 % for  $\rho_{\text{max}} 60 \Omega \cdot \text{cm}$ ; radial gradients  $R \leq 15 \%$  for  $\rho_{\text{max}} 20 \cdot \text{cm}$ ,  $R \leq 18 \%$  for  $\rho_{\text{max}} 60 \Omega \cdot \text{cm}$ ; oxygen content  $< 10^{18} \text{ cm}^{-3}$ .

### Silicon monocrystals with a diameter of 76 mm

This material has been obtained by zone crystallization of silicon in the form of a rod molten without any contact with the crucible in the zone of operation of a high frequency inductor. This process is known as the crucibleless crystallization process or as the floating zone (FZ) process. The material obtained by that method is used most often in instruments requiring silicon with a higher resistivity than featured by the material obtained by Czochralski's method (high voltage components, quick-switching power diodes, power thyristors, silicon-based optoelectronic components, etc).

Silicon monocrystals prepared by the crucibleless method are high purity materials, especially as far as their content of carbon oxygen and other impurities is concerned (e.g. heavy metals) which are generally known to exert a detrimental effect on silicon properties.

Their application gives considerable economic advantages to their users. The technology developed at the Institute is characterized by the following properties of the monocrystals: length (depending on equipment type) up to 1000 mm; diameters of monocrystals 76 mm; crystallographic orientation  $\langle 111 \rangle$ ; rated resistivity range  $20 \dots 200 \Omega \cdot \text{cm}$ ; deviation

from the rated value –max. 25%; resistivity gradient  $G \leq 20\%$ ; lifetime of minority carriers –  $20 \dots 40 \Omega \cdot \text{cm}$ ,  $\tau \geq 50 \mu\text{s}$ ,  $40 \dots 200 \Omega \cdot \text{cm}$ ,  $\tau \geq 100 \mu\text{s}$  (without dislocations).

#### Silicon monocrystals doped with phosphorous by the neutron transmutation method (ND-Si)

The phosphorus doped material by the ND method is of higher quality than that into which the phosphorous has been introduced by conventional methods (e.g. by introducing the phosphorous in a process involving the preparation of the monocrystal by diffusion). The neutron bombardment takes place in reactor channel in which one of the natural isotopes of silicon  $^{30}\text{Si}$  (average content in ordinary silicon is about 3.12%) undergoes transformation into phosphorus, according to the reaction



Basic advantages of the material are as follows: possibility of obtaining strictly defined rated resistance values; highly homogenous distribution of phosphorous in the material both in macro-spaces and in mini-spaces.

The good properties of these materials contribute directly to an improvement of the quality of components made from them. At least two advantages stemming from the utilization of neutron-doped silicon deserve to be mentioned. The first of these is of an economic nature, and is due to the fact that a much higher percentage of components manufactured conforms to the requirements of the so-called designed classes than in the case of conventional materials. The other advantage lies in the obtaining of high voltage classes for components manufactured basing on the neutron doped material (e.g. in power diodes).

The technology of obtaining doped silicon by the ND method comprises several stages including: the preparation of monocrystals (done at the Institute of Elec-

tronic Materials Technology), neutron bombardment in specially adapted channels of the reactor, relaxation of post-irradiation flows, and measurements of physical, electrical and structural properties (performed at the Institute of Electronic Materials Technology). This technology makes it possible to obtain monocrystals exhibiting the following properties: diameter of monocrystals – up to 51 mm  $\pm$  0.2 mm, rated resistivity range offered 25...130  $\Omega \cdot \text{cm}$ , deviation from the ordered resistivity max. 10%, resistivity gradient  $G \leq 5\%$ , phosphorous distribution inhomogeneity  $J \leq 8\%$ , lifetime of minority carriers 25...40  $\Omega \cdot \text{cm}$   $\geq 50 \mu\text{s}$ , 40...100  $\Omega \cdot \text{cm}$   $\geq 100 \mu\text{s}$ , crystallographic orientation  $< 111 >$ , concentration of acceptors  $6 \times 10^{12}$  at/cm<sup>3</sup> or  $9 \times 10^{12}$  at/cm<sup>3</sup>, without dislocations.

#### Silicon epitaxial layers

Silicon epitaxial layers are used commonly in the technology of semiconductor instruments, and especially in the manufacture of discrete components and bipolar integrated circuits. A monocrystalline silicon layer of required thickness, resistivity and conductivity type is deposited on a monocrystalline silicon bed. The epitaxy process is conducted in a gaseous phase at temperatures ranging from 1320...1470 K, hydrogen being the carrier gas. Silicon tetrachloride vapours are the source of silicon in the system while that of the dopant is constituted either by phosphine or diborane. In this way the n-n<sup>+</sup>, p-p<sup>+</sup>, n-p<sup>+</sup> etc. epitaxial junctions are obtained.

The theoretical and experimental studies carried out at the Institute of Electronic Materials Technology have led to the development of technologies involving the formation of silicon layers exhibiting high resistivity gradients at the bed-epitaxial layer interface, and also of high-resistivity layers. These find a wide application in the manufacture of microwave and optoelectronic components.

POLAND

## ELECTROPLATING PROCESS EQUIPMENT PROFILED

Warsaw POLISH TECHNICAL REVIEW in English No 2-3, 1985 pp 13-14

[Article by Karol Patorski, Jerzy Strzelecki: "The MINI Automatic Electroplating Machines"]

[Text]

The Electroplating and Lacquering Equipment Works ZUGiL, Wielun, are one of Europe's largest manufacturers of equipment for electroplating and lacquering operations. Paint shops, electroplating plants and technological wastes treatment plants operating satisfactorily in over fifty different countries of the world make up the showcase for the ZUGiL Works at Wielun.

The design and starting of production of the MINI automatic electroplating machines are the latest achievement of the ZUGiL Works. These automatic electroplating machines are designed for the application of noble metal coatings on small-sized objects. A representative of the MINI automatic electroplating machines, a program-controlled electroplating machine for the gold-plating, rhodium-plating and tungsten-plating of contacts of encapsulated switches was awarded a gold medal at the 1984 Poznań International Fair.

The objects to be electroplated using the program-controlled automatic electroplating machines are suspended from hangers or placed in drums or baskets and transferred automatically through all work stations, according to predetermined technological programs. The dipping times may vary in the baths of the basic processes, and may also depend on the magnitude of the electric charge passed.

As shown in the diagram, the main assemblies of the MINI automatic electroplating machine are: electroplating

vat lines 1, transport system 2, process installations 3, charge carriers 4, supporting structure 5, shields and covers 6, electrical equipment 7, control system 8.

The MINI automatic electroplating machines are designed and built on an individual (i.e. single-piece) basis, depending on the size of the objects to be electroplated, and on the required size, kind and thickness of the coating and on the electroplating technology employed.

**Line of electroplating vats** is arranged using vats made of plastic material resistant to the action of the electroplating bath and temperature. The electroplating vat line shape, and hence that of the automatic electroplating machine, is optional—depending on floor-space available, a linear arrangement or one of the form of letters L or U being the most often used. The electroplating vats can be replaced without disassembling the transport system. The vats are provided with movable pouring baffles making it possible to feed the electroplating baths into the vats to attain a required bath depth.

**Transport system** comprises a track with a single main rail and bracked-type blocks moving along it. The track is mounted on a supporting structure and is independent of the electroplating vats, which eliminates undesirable stresses, while leaving the walls of the vats free for fixed-type installations and periodically installed equipment.

Application of the bracket-type blocks has eliminated road wheels on the side of operators, which results in an improvement of work safety and tractive qualities of the transport system.

**Process installations** used in the automatic electroplating machines include all indispensable technological installations, such as: evacuation of noxious vapours from above the electroplating bath surface, washers feeding installations, electroplating bath circulation, installations draining system, electric heating. Exhaust fans placed along the shorter sides of the vats are used to remove the vapours. The solution has made it possible to shorten the automatic electroplating machines by some 35 % in comparison with traditional design versions, their widths being increased only very slightly. The shortening of automatic electroplating machine length saves electroplating plant floor space and, in many cases, makes possible the reduction of the number of hoisting blocks. Exhaust fans are connected with collecting pipes by means of Plastiroll-type flexible hoses that are both easy to assemble and operate. The installations of liquid media are provided with flexible plastic hoses. The application of flexible hoses makes possible the achievement of a maximum compactness of automatic electroplating machine design. The electroplating baths in the vats are heated directly by means of electric heaters whose sheathing depends on the composition of electroplating baths. The heating system circuits are equipped with automatic temperature control circuits.

The main vats electroplating bath circulation systems, and especially those used for gold-plating, are independent for each electroplating bath, which reduces to a minimum the required amount of electroplating baths and, in the case of contamination and damage to bath circulation components, the losses are limited to a minimum. Trickle trays placed under the electroplating bathes provide an additional protection against losses met with generally during overhauls or in case of a breakdown.

**The control system** is equipped with a universal-type programmable controller PC-COMPACT. This is a digital electronic system designed for industrial process control application and equipped with an

EPROM-type programmable memory, which through the intermediary of a suitable operating program, imparts specific control qualities to the PC-COMPACT controller. The large storage capacity and highly flexible programming language make possible the execution of even very complex control tasks by that control system. A good example reflecting the capabilities of the control system is its functional integration in the automatic electroplating machines herein discussed for gold-plating, rhodium- and tungsten plating of contacts of encapsulated switches.

This automatic electroplating machine performs three independent technological programs: gold-plating 4 minutes' production pace, rhodium-plating 17.5 minutes' production pace tungsten-coating 20 minutes' production pace. Three groups of contacts with different coating thickness and requiring different current intensities may be gold-plated simultaneously. Various groups of contacts may be introduced into the automatic electroplating machine just in the order of their leaving the production line without there being any need for storage and selection of the contacts by the operators. Additional buffer work stations at the inlet of the automatic electroplating machine are not required either.

The control system identifies the contacts thanks to an identification mark placed on the hanger or basing on information supplied by those working at the loading station. On the basis of the current content of the automatic electroplating machine, the control system makes the decision whether or not to accept the identified hanger, and when there is no such possibility the hanger waits for being charged for the duration of one production pace (and not longer). The time spent by the contacts in the gold-plating bath depends on the preset value of the electric charge fed. As the automatic electroplating machine comprises four gold-plating vats with independent electroplating bath circulation systems (i.e. different bath efficiencies), it is essential that the control system select, on the basis of vat number and the stored type of contacts, the required magnitude of the electric charge and current intensity at the very moment of placing the hanger in the electroplating vat. Measure-

ment of electric charge (counting of pulses of the charge converter to give a pulse train) and its comparison with the preset value is done also by the control system. In order to ensure the periodic nature of operation of the automatic electroplating machine, the electric charge measurement must be performed over a strictly defined period of time, equal to half duration of the production pace. Should such measurement be started prematurely or belatedly owing to faulty initial presetting, a limiting circuit will be triggered off and will simultaneously inform process operators about faulty setting condition.

The control system employed also makes possible the manual control of block movements by means of manipulators mounted on them, the indispensable interlocks being maintained (end of track blocking system, anti-collision blocking, hoisting block horizontal travel interlocking system acting at intermediate arm positions). In automatic operation mode, the same interlocks are utilized along with the additional blocking of entry to an already occupied station.

In order to facilitate operation and fault finding, the control system also supervises the operation of digital displays showing the number of the given step of the technological process for each

hoisting block, and also the signalling of production pace completion and the group signalling of the causes of automatic work cycle stoppage (one the interlocking systems have started to function or the STOP cut-out has been switched on). The control system makes moreover possible the service operation in the „step-by-step“ mode, independently for each hoisting block, or operation starting from a given, selected step. After a temporary voltage decay, further automatic mode operation may be started by process operators at any point of the work cycle, the internal store content being intact for at least 100 hours thanks to electric power supply from chemical sources. It is possible to obtain gold-plated coatings of strictly defined thickness thanks to making the time spent by objects in the gold-plating bath dependent on the magnitude of the electric charge required and taking into consideration the bath efficiency in the various vats which in turn limits the number of rejects and gives considerable savings of the gold. The investment outlays required for the purchase of this automatic electroplating machine will be repaid within some 2.5-3 years as a result of the savings of electroplating gold due to the considerable reduction of coating thickness and height non-uniformity.

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POLAND

## NEW MARINE DATA LINK EQUIPMENT

Warsaw POLISH TECHNICAL REVIEW in English No 2-3, 1985 pp 11-12

[Article by Stefan Kijak: "Data Transmission Equipment For Marine Applications"]

[Text]

The TELKOM-TELETRA Wielkopolskie Tele-electronic Works, Poznań have designed and started the production of UTD-100 data transmission equipment operating on a short-wave radio link. This line of equipment ensures efficient and reliable communication between a ship and its owner.

The application of a microprocessor has made it possible to develop equipment meeting all requirements and recommendations of the CCIR-476-1 and has also facilitated its extension to make operator's work easier e.g. by the inclusion of a large memory and the hard-wiring of testing procedures.

The UTD-100 equipment can operate in one of the following modes: *ARQ* (Automatic Request for Repetition), *FEC* (Forward Error Correction), *SELFEC* (Selective Calling Forward Error Correction), *DIR* (Direct Transmission or Reception) and *CW* (Continuous Wave).

The *ARQ* is a single-channel synchronous system with automatic request for repetition in which three-character blocks are transmitted by the data sending station in the direction of the data receiving station. Single-character control blocks confirming the correctness of the received information or requesting repetition are transmitted in the opposite direction.

The calling station is always the master station, while the one being called becomes the slave station irrespective of the direction in which the information is

transmitted. The contact establishing station sends a diblock calling sequence which also contains the address of the station being called. After receiving the calling sequence, the station being called responds by sending a specified, single-character block. The calling procedure is ended when the calling station has received two successive, identical confirmations. According to the CCIR476-2 international recommendations the calling sequence may be repeated 32 times.

The calling sequence transmission duration has been extended up to 2.5 minutes in the UTD-100 equipment. This has been due to the fact that certain coastal stations operate in the "horizon sweeping" mode, the sweeping duration being of the order of 2 minutes.

Once the calling procedure has been completed, the stations start sending information. The information transmitting station emits the information block for 210 ms and this is followed by a 240 ms intermission, the block emitted being stored in the memory system until an either confirmation or repetition request has been received. After receiving each block, the station being called emits a confirmation or repetition request message for 70 ms, followed by a gap of 380 ms, so that a complete transmission cycle lasts 450 ms with the transmission of the information block and confirmation lasting for 280 ms. The remaining time is taken up by the double travel of the radio wave over the distance separating the two sta-

tions (propagation time), and also by a certain time lag characteristic of the equipment (UTD-100 and radio stations). Division of the time into the transmission and reception periods and the subsequent reception interlocking in the remaining time intervals is of great importance to transmission quality. Owing to interlocking, the receiver does not interpret signals arising from noise. For a given transmission cycle duration both the master and slave stations control the programming time permanently, the time of propagation also changing in the course of transmission. The moment of starting the reception is determined by the master and slave station, depending on the time of propagation.

*FEC* is a synchronous system transmitting an uninterrupted stream of characters from the transmitting station to many receiving stations (or to stations selected in the *SELFEC* system).

The transmitting station emits each character twice: after the first transmission of a given character there takes place a retransmission of the first character. Each character is thus transmitted twice with a time shift of 280 ms.

The information receiving station checks each character twice and prints out the undistorted one (from the first transmission or retransmission) or a space character when both characters are distorted. Detection of faulty characters is done in the following way in the *ARQ*, *FEC* and *SELFEC* operation modes.

The equipment operates on a radio link at a rate of 100 Bd, using a 7-element code without the **start** and **stop** elements, the ratio of name emitter states remaining constant and equal to 3:4. Every information or control character with a different ratio of name emitter is regarded as being erroneous. The bit duration is measured continuously by the receiver. When the bit duration is found to vary well outside the permissible tolerance levels set at 1/6, 1/4 or 1/3 of bit length, the given character is considered to be incorrect.

As the UTD-100 cooperates with a telephone channel of a short-wave radio station, the conversion of signals is done by a modem. This is a frequency modulated modem with mid-channel frequencies of 1500 Hz, 1700 Hz or 1900 Hz and a frequency shift of 170 Hz. The various mid-channel frequencies are required for

ensuring cooperation with various types of equipment in current use, 1700 Hz being the recommended frequency. During the designing of the modem, a great deal of attention has been given to the problem of optimizing the receiving filters, which is of particular importance when utilizing channels characterized by high noise levels.

The *SRW* system used is the channel demodulator is highly effective in the receiving levels of 0 to -48 dBm and, hence, facilitates the operation of the discriminator.

The linear signal detector blocks the release of information from the demodulator when the linear signal level drops below a preset limit. The demodulator also incorporates the *ARCZ* circuit compensating the permissible frequency deviations of the carrier waves of the shipborne and coastal radio stations. This circuit ensures a correct operation of the demodulator at mid-channel frequency shift values of  $\pm 65$  Hz.

The UTD-100 equipment is manufactured basing on the MCY 7880 (Intel 8080) microprocessor system, and incorporates the following functional blocks: microprocessor with interruption circuits, a user's RAM store, a PROM store (program storage), operator's panel (built-in or free-standing), a circuit interfaced with a teleprinter, linear circuits, a modem, and a feeder.

The equipment operation and control test algorithms are hard-wired in the program storage system.

The operator's control panel makes possible the control of the equipment and the transmission process, and incorporates all indispensable manipulation elements such as: the operation mode switch, transmission control buttons, equipment state indicators, transmission course information display, etc. The teletype-interfaced circuit controls the operation of the teleprinter and also converts voltage signals into current signals required for controlling teleprinter operation.

Linear circuits control the operation of the modem, the RAM memory being available to the user. The RAM memory capacity is equal to 4000, 8000, 12000 or 20000 characters, depending on requirements. The smallest memory capacity of 4000 characters is provided as standard for each piece of UTD-100 equipment.

Memories with larger storage capacities are optionally available upon user's request. The transmitting and receiving memory may be fed with any information from a local teleprinter or telegraphic line. Information output from the memory to the transmitter takes place during transmission. After having been transmitted, the information is not lost and may be transmitted many times over. During transmission the text of the message may be printed out for control purposes, on a local teleprinter. The information accumulated in the transmitting memory may have the form of suitably labelled messages which may be transmitted in any desired sequence. Any message can be also retrieved from the memory by peripherals and other types of remotely-positioned devices. The operator can print out any message after specifying its address label, and also supplement or change its contents. It is also possible to scan the storage content by printing out on a teleprinter several score of the initial characters of each message. In the receiving condition the information being received is loaded into the system memory starting from the first free storage cell. This information is printed out automatically on a teleprinter. The received information is stored in the system memory and can be output repeatedly, when required. The memory is protected against short-lasting (up to 10 s), accidental power cuts. The equipment contact with the teleprinter is such that it may be used for hooking up any type of a paper tape reader - equipped mechanical or electronic teleprinter. The teleprinter contact incorporates the following two circuits: the active transmitting circuit cooperating with the teleprinter receiver and current-controlled, and the active receiving circuit cooperating with the teleprinter transmitter. The teleprinter reader may be stopped by reducing the current intensity

in the teleprinter transmitter circuit or may be controlled by an entirely independent circuit. The independent circuit makes it possible to start reader operation either in continuous or character-by-character modes. A contact compatible with TTI circuit voltage levels may be also supplied.

Using the teleprinter, the operator may introduce local time parameters into the UTD-100. The time reading may be done at operator's request or be printed out on the teletype automatically after the transmission has ended and the equipment has passed into the „stand-by“ condition. The local time value is not transmitted between the individual pieces of equipment, which facilitates operator's work in that he has been thus freed from having to log each received message. A given subscriber is selected in the network by transmitting a suitable address signal entered from a local teleprinter to address memory. It is possible to use five-digit addressing (for coastal radio stations) and four-digit addressing (for shipborne stations). Own address is set by altering the combination of short-circuiting switches inside the UTD-100 equipment.

In order to greatly facilitate repairs of the UTD-100, it has been provided with the *LOOP* operating condition (testing routine) which makes possible the performance of many different testing procedures. There are two loops: the first of these is an analogue loop linking the modulator output with demodulator input, while the second loop is constituted by a digital loop connecting the transmitter with the receiver still in front of the modem. It is also possible to test signalling lamps switches, the teletype, and to perform internal tests allowing to pinpoint the faulty package.

**Technical data:** power supply 220 V 47 - 63 Hz, 10 V A, dimensions 490x36x172 mm, weight 15 kgs.

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POLAND

## 'UNITRA-CEMAT' LINE OF CONDUCTING, DIELECTRIC PASTES

Warsaw POLISH TECHNICAL REVIEW in English No 2-3, 1985 pp 8-9

[Article by Selim Achmatowicz: "Electronic Pastes"]

[Text]

The Electronic Materials Research and Production Centre UNITRA-CEMAT has been manufacturing electronic pastes since 1970 when the demand for conducting pastes, required for the manufacture of ceramic capacitors, rose very steeply. The scientific research and technical development work conducted at UNITRA-CEMAT has made possible the gradual extension of the range of electronic conducting pastes manufactured to include those containing noble metals as well as resistive and dielectric pastes used in thick-film circuits designed to meet particularly stiff requirements.

The term „electronic pastes” is used to describe a group of materials constituted by suspensions of various powders in an organic carrier medium, these suspensions exhibiting a host of different useful properties. This fact is utilized for dividing the electronic pastes into groups. Depending on the techniques of their application, there are pastes designed for spraying, painting, dipping, paint-screen printing etc., which exhibit different viscosities and rheological properties. From the point of view of the thermal characteristics of the coating formation process, the following pastes are distinguished: high-temperature pastes, i.e. those baked at temperatures of above 770° K and drying at temperatures of between 370...420 K so-called conducting varnishes and also thermo-setting or chemically-hardened (crosslinking-type) pastes i.e. adhesives.

### Silver-based conducting pastes

This is by far the most common group of conducting pastes which are manufactured in a very wide range of types so that it is possible to select suitable pastes for a large number of electronic components. After application on a given base material, these pastes require baking at temperatures in the range of 820...1120 K. It is therefore necessary to use bases which do not change their properties at those elevated temperatures. The silver-based pastes are designed chiefly for the manufacture of capacitor ceramics, aluminum and steatite materials, electrical porcelain or glass.

They are used commonly in the manufacture of ceramic capacitor plates of various types, electrodes, resistors, thermistors, piezo-ceramic transducers. They also find application as heating elements, e.g. for heating motor-car windows. The silver-based pastes exhibit an excellent conductance and good soldering qualities when using SnPb-based alloys. Thanks to the addition of such extra components as glazes, they exhibit a very good adhesion to the base material and do not lose that particular property after soldering.

The L-101 solvent-evaporating lacquer used for the soldered electrodes of tantalum capacitors, and the K-111 chemically-hardened conducting adhesive may be also included in that group of electronic pastes.

## Resistive pastes

Three series of ruthenium-based resistive pastes are manufactured at UNITRA-CEMAT:

- R-310 – six pastes with a resistance range of  $30 \dots 10^6 \Omega/\square$  temperature resistance coefficient (TWR)  $\pm 150$  ppm/K stability after 1000 hours 2 %

- R-320 – six pastes with a resistance range of  $10 \dots 10^6 \Omega/\square$ , TWR value  $\pm 100$  ppm/K, stability after 1000 hours 1 %

- R-3200 – three pastes with a resistance range of  $1 \dots 50 \Omega/\square$ , TWR value  $\pm 200$  ppm/K

These pastes are designed for the production of highly stable resistance layers in thick-film microcircuits, fixed and variable resistors on alundum and steatite bases. In order to obtain optimum properties of those layers it is essential to resort to baking in air at 1100 to 1150 K. A number of electronic pastes may be used as resistor terminals, the application of UNITRA-CEMAT pastes, and of the P-202 palladium silver paste, being recommended. By mixing the adjacent members of paste series, intermediate resistance values may be obtained. It is therefore relatively simple to manufacture resistors with resistances ranging from  $0.5$  to  $10^7$ .

The range of these resistive pastes is complemented by protective pastes used for coating the resistors with a glaze film in order to increase their resistance to the action of environmental factors and to limit other side effects due to corrective processes. The D-202 paste (green) is designed specially for laser correction purposes.

## Pastes

### for thick-film integrated circuits

A fairly wide range of conducting and dielectric pastes are manufactured at UNITRA-CEMAT and these, together with

the pastes dealt with in the foregoing text, make possible the production of thick-film integrated circuits of varying degrees of intricacy. Circuits with increased operating reliability and high degree of integration may be produced in a multi-film form using the conducting pastes R-303 (Au) and P-304 (AuPt) coupled with the D-401 insulating paste (6-8 layers). The multi-layer systems may be also obtained using the P-202 (AgPd) and P-401 (AgPt) pastes coupled with the D-401 paste.

The above mentioned pastes may be adopted for various assembly methods: the gold-based P-301 and P-302 pastes being particularly recommended for wire micro-assembly operations. The silver (palladium P-202 and silver) platinum P-401 and P-402 pastes may be also used in the above operations, although they are designed primarily for assembly using soft solders.

Special-purpose pastes are also manufactured by UNITRA-CEMAT, an example of these being provided by the set of pastes developed specifically for plasma-type display units. This set comprises the P-727 nickel paste which is particularly resistant to cathode sputtering, the D-220 contrast paste, the D-451 insulating paste, and the P-124 silver-based paste.

All these pastes cooperate with one another, and are designed for use on sodium/calcium glass.

Research and development plans of UNITRA-CEMAT cover such problems as: further improvement of traditional pastes, pastes on base metal matrices, baking in an atmosphere of inert gas, polymeric pastes.

The production of thick-film materials for the manufacture of solar cells will be started in a not too distant future along with that of polymeric pastes for rigid and flexible bases (switches) and of copper-based pastes eliminating the very expensive gold-based pastes in multi-layer circuits.

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## COMPOSITE ELECTRIC CONTACT MATERIALS

Warsaw POLISH TECHNICAL REVIEW in English No 2-3, 1985 pp 9-10

[Article by Jacek Senkara, Jan Kowalczyk: "Contact Materials With An Infusible Phase"]

[Text]

Contact materials constitute an important element of nearly every electrical instrument. Contact materials used in case of a stable electric arc are constituted by composites comprising two-phases. The first of these is a high-melting component, and the other by a material exhibiting good electrical and thermal conductivities. Materials of that kind find a very wide range of possible application, e.g. for the manufacture of small- and medium-load relays and switches, and also of switches used in household electrical appliances, and section switches and couplers.

The composite contacts can be used in air circuit-breakers (e.g. W-Ag, Ag-Ni), oil circuit-breakers (W-Cu, Mo-Cu), vacuum-type switches (W-CuSb, Cu-Cr) and also switches operating in an atmosphere of SF<sub>6</sub> (W-Cu). Many contact materials containing a high-melting phase have been patented in the world. These may be divided into the following two basic groups:

- two- or multi-component alloys with a limited miscibility in the solid state, obtained by metallurgical methods from the molten state and subjected to heat treatment in order to achieve the separation of intermetallic compounds reinforcing a matrix exhibiting a good electrical conductivity,
- composites containing a phase resistant to electric arc erosion (W, Mo, Ta, Cr, Fe, Re, nitrides, carbides), and a well conducting phase (Au and Cu) with certain additives preventing contact pitting,

activating the sintering process or improving the interface adhesion properties (these composites are obtained by powder metallurgy methods).

The present-day trends aimed at increasing the operating reliability and extending the service life of electrical equipment which have to meet stringent requirements with respect to operating conditions are finding their expression in efforts being made to modify the classical composites with a view to imparting new properties to them by suitably changing their composition and structure. These development trends are also aimed at reducing the consumption of noble metals and of strategically important ones. Modern materials engineering and metallurgical technologies are being used for that particular purpose, including those of isostatic sintering or explosive forming. Owing to the high activity of the constituents, all processes are conducted under high vacuum or in pure reducing atmospheres.

The fundamental technological problems are as follows: the obtaining of a suitable structure of the infusible phase of the composite, and the achievement of a good interfacial adhesion.

Depending on requirements to be met by a given contact material, the high-melting component may be uniformly distributed over the fusible matrix, or constitute an erosion-resistant matrix packed with a well conducting phase.

This is illustrated on the pictures of materials obtained at the Institute of Electronic Materials Technology (Figs 1a and 1b). These composites were prepared by sintering the components in the presence of the Mo-Cu liquid phase, followed by saturation of the sintered porous matrix (W-Ag).

Surface phenomena occurring at the interface between the solid and liquid phases, and also the physico-chemical phenomena connected with the activation of sintering to obtain an infusible, porous matrix with a desired structure play an important role in the technological processes involved.

A fracture of a porous tungsten section obtained by the technology developed is shown in Fig. 2. The porous matrix may be saturated with liquid Ag, Cu and their alloys, depending on user's requirements. Works on the development of contact materials based on infusible metals has been proceeding for the past few years now at the Institute of Electronic Materials Technology. As a result, a number of technologies have been developed. These have applied directly in the everyday production practice of the Scientific and Production Centre for Electronic Materials.

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## R&D TRADE ASSOCIATION HOLDS FAIR

Warsaw POLISH TECHNICAL REVIEW in English No 2-3, 1985 pp 21-22

[Article by Andrzej Witkowski: "System Innovations"]

[Text]

The ZORPOT Association of Centres for Technical Advance and Expert Appraisals, Warsaw, a member of the Association of Polish Mechanical Engineers and Technicians has developed a computer system called INNOVATIONS. The aim of the system is to promote technical progress by creating adequate motivation for the practical implementation of new inventions and research work results.

The INNOVATIONS computer system records scientific and technological achievements, interesting design solutions and creative ideas that have so far not been made sufficiently popular and utilized. This system is used for selecting the most interesting ideas and concepts which have a chance of being exported, and also facilitates contacts between inventors and potential manufacturers, and ultimately leads to production start-up.

More than 1000 new developments have been registered so far. The system INNOVATIONS is backed by the activities of 17 local ZORPOT representatives who gather information about the so far unutilized scientific and technological achievements, additional support being offered in that respect also by organizations of the Association of Polish Mechanical Engineers and Technicians attached to individual production works.

The scientific and technological information thus collected is then presented by ZORPOT at various exhibitions held in Poland and abroad. ZORPOT is moreover

concerned with the elaboration of technical documentation along with design, technological and operating documentation, and also manufactures prototypes and models and then performs suitable tests. ZORPOT also handles patent clearance problems and organizes pilot lot-scale production.

Basing on the INNOVATIONS system, ZORPOT organized in 1984 in Warsaw an Exchange-Fair for Realistic and Phantastic Ideas, with a view to contacting those having such ideas, and also patents and interesting solutions with people representing the industry, commerce and handicraftsmen's sector.

The idea of holding such a meeting proved highly successful. It was attended by more than 10,000 people from Poland and abroad, and a number of concrete agreements were concluded, so that many of the presented solutions will ultimately find its way to practical application.

The next exchange fair for technical ideas will be organized by ZORPOT in the autumn of this year, foreign exhibitors being cordially invited. Those wishing to take part in that event should address their applications to: ZORPOT Association of Centres of Technical Advance and Expert Appraisals, ul. Elbląska 10, 01-737 Warsaw.

The next part of the present article is devoted to some of the more interesting products that were exhibited at the Exchange Fair for Realistic and Phantastic

Ideas and will be manufactured or implemented in the near future.

#### **The ON 05 warp extension meter**

This equipment has been developed at the ZWOLTEX Cotton Industry Works, Zduńska Wola, for the continuous, automatic control of warp extension during its dressing or joining. It can find application in the textile industry in the weaving mill preparatory shops. This meter may be also utilized for determining the ratio of any two quantities given in digital form. The ON 05 meter design is based on medium-scale integration TTL components.

#### **A water demineralization plant**

The water demineralization plant offered by the Technical University of Warsaw is a source of water free from cations and anions as well as mechanical impurities and organic substances. It may find application at industrial works requiring high purity water e.g. in the optical industry (at glass grinding shops), in paint shops (for the electrophoretic protection of surfaces), in the chemical and food industries (for the manufacture of reagents and nutrients, respectively). The demineralized water is obtained on a continuous basis in a number of ion exchangers removing cations and anions, successively.

This plant is equipped with an ion exchanger regeneration system and with automatic process control and water purity signalling systems. It has an output of 0.5 m<sup>3</sup>/h, the final conductance of the water being equal to 5 S/cm. Installation floor space requirement 6 m<sup>2</sup>; installation height 3 m. Structural materials used for the construction of the plant are mainly glass and plastics, small amounts of acid resistant steel being employed.

#### **A plant for the neutralization of electroplating solutions**

This plant, which has been also developed at the Technical University of Warsaw, has been designed for removing spent electroplating baths containing salts of heavy metals. It may be also used for the purification of wastes containing cyanide and chromium ions, provided that it has been equipped additionally with special neutralizing reaction vessels. This

neutralization plant may find application in galvanizing plants with a variable production program.

The heavy metals are removed from the post-electroplating liquors by a precipitation of their hydroxides using alkalis, followed by sedimentation of the precipitates in a number of settling tanks.

The process is continuous, and the required degree of purity is ensured thanks to the automatic process control (at several stages) and careful monitoring of the pH value of the solution.

Plant output is 10 m<sup>3</sup>/h, power and floor space requirements 4 kW and 25 m<sup>2</sup>, respectively.

#### **Measurement of the intensity of wastes flow in an open channel**

The contactless method of measuring the intensity of wastes flow, developed at the MIKROMAT Works, Warsaw, consists in recording by means of optical sensors of disturbances occurring on the surface of the flowing wastes. These disturbances have the form of electrical signals which are then converted to give a correlation function transient whose maximum value is a measure of the time required by the wastes to flow past two detectors. This in turn is equivalent to the rate of wastes flow. Further processing of the wastes flow data yields the average velocity of flow, and also a net balance of the amount of flowing wastes. Microprocessors have been used for flow data processing purposes.

This method has been used successfully at the Mazowsze Oil Refining and Petrochemical Works, Plock.

#### **A device for reducing fuel consumption in motor-car engines**

This device has been developed at the Technical University of Kielce (Polish Patent No. 126166), and the principle of its operation consists in a variation of the fuel mixture air factor value when braking using the engine is applied.

This is achieved by cutting of the fuel flow path in the carburettor during engine's idle run. Utilization of that equipment makes it possible to achieve a nearly 10% fuel consumption in city driving conditions. It has been also found that unit

emission of carbon monoxide has been reduced by some 20 per cent and that of hydrocarbons, by some 16 per cent. The device is of a very simple design and is easy to manufacture. It has been applied so far in the following motor-cars: FIAT 126p, FIAT 125p, FIAT 128, SKODA 105, SKODA 100, LADA 1300, POLONEZ, and in ŽUK and NYSA delivery trucks and vans.

#### **A non-destructive method of steel testing**

The non-destructive method of steel testing developed at the Institute of Power Industry, Warsaw, consists in a contact-type measurement of magnetic coercive force which is a function of the magnetic field intensity of a unit pole produced in the material being tested due to contact with a permanent magnet.

This method makes it possible to determine structural changes brought about in the material as a result of decarburization, cold work, dispersion of precipitated constituents, microcracks, impurities, etc. The result of measurement is compared with the values obtained from measurements carried out on reference samples.

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## NEW ENGINEERING PRODUCTS, TECHNOLOGIES PROFILED

Warsaw POLISH TECHNICAL REVIEW in English No 2-3, 1985 pp 22-31

[Article: "Systems Innovations"]

[Text]

### A NEW EPOXIDE MOULDING COMPOUND

The Institute of Polymers, Polish Academy of Sciences, Zabrze, has developed a number of technologies for the manufacture of a series of original plastics. One of these is the „epoxynox”, a thermosetting moulding compound used for the moulding of intricately-shaped cast profiles by both compression and injection moulding techniques. This moulding composition is outstanding for its excellent heat resistance and dielectric strength as well its high chemical stability. It may find wide application in engineering and electrical industries for the manufacture of gear wheels, electro-insulating housings, nuts, etc. This moulding compound may be produced in the form of a powder, granules or a dough-like mass. Mouldings manufactured from it exhibit a flexural strength ranging from 70 MPa to 120 MPa, an impact strength of 2 to 16 MPa, heat resistance after Martens of 273 K to 333 K, a moulding shrinkage of 0.1 to 0.8 %, and a loss angle of 0.006.

### A CONOSCOPE

The conoscope built at the Technical University of Warsaw is used for the optical orientation of solid bodies and plates made of optically birefringent materials (chiefly crystalline). The principle of conoscope operation consists in the interpretation of the image of isochromatic lines produced after convergent beams of polarized light have passed through the object being studied. The object is fastened either in a rotary clamp immersed in a cell

containing an immersion liquid or, in the case of a plate, on a rotating table making possible the performance of angular measurements. In order to adjust the optical system for various dimension of objects, interchangeable objectives are employed. The image produced by the conoscope is observed directly on a screen or via an additional eyepiece. The image can be also photographed.

Technical data: dimensions of objects being examined: lengths of up to 120 mm, diameters of up to 50 mm, lens aperture variation range 35°...90°, light sources: a mercury discharge lamp or a He-Ne laser, instrument base dimensions (length x width x height) 700 x 250 x 420 mm.

### A CHANNEL-TYPE ELECTRON MULTIPLIER

The channel-type electron multiplier built at the Technical University of Gdańsk is made of a spiral-shaped silicate/lead glass tube. At the extremities of that tube there are metal electrodes. During thermal treatment in hydrogen, polycrystals of lead are formed in the surface layer of the glass, which results in an increase of surface conductivity by a few orders of magnitude. This layer features a good secondary emission.

A voltage applied to the electrodes generates inside the tube an electric field accelerating the freed electrons. Owing to secondary emission, an electron is multiplied some  $10^8$  times. An electron obtained in this way can be recorded by an electronic counter.

Technical data: glass tube length 0.1 mm, outside diameter of tube 1.5 mm, resistance  $10^5 \Omega$ , maximum annealing temperature 670 K, maximum operating temperature 340 K.

## A GANTRY CRANE WITH A HOOK-TYPE WINCH

The DETRANS Research and Development Centre for Cranes and Handling Equipment, Bytom, has developed a gantry crane provided with a mobile hook-type winch designed for reloading machines, structural elements, metallurgical products and long cargoes. The load carrying structure of this gantry crane is constituted by one girder and supports (fixed and rocking supports) made of welded elements with rectangular cross-section. Three rails are fastened on the girder: one of the rails is vertical in order to accommodate the vertical reactions of the hoisting winch, while the remaining two are arranged horizontally to take on the couple of forces produced due to the eccentric loading of the girder by the winch proper. The girder structure is such that no communication platform along the girder is required. The gantry crane travel mechanism is equipped with eight two-wheel rockers, four of them being powered. The travelling winch with the hook travels along the three girder rails by means of two wheel sets. These gantry cranes are manufactured by the FA-MAK Machinery and Equipment Factory, Kluczbork.

**Technical data:** main lifting capacity 320 kN, auxiliary lifting capacity 80 kN, gantry crane span 75 m, total installed load 125 kW, working and main lifting speeds 7.2 m/min, auxiliary lifting speed 14.7 m/min, gantry crane travelling speed 32.8 m/min, gantry crane weight 183 tons.

## A BETA-REFLECTION LAYER THICKNESS METER

The Institution of Nuclear Research, Warsaw, manufactures the GIL 41 laboratory layer thickness meters designed for the non-destructive, highly-accurate measurement of the thickness of layers, especially those of such noble metals as silver, gold, platinum, rhodium, iridium, palladium. The principle of operation of these instruments is based on the phenomenon of beta radiation reflection. The indispensable condition of performing the measurements is a suitable difference between the automatic numbers of the coating and the base, which should be equal to at least 5. The minimum measuring field is nearly 0.6 mm<sup>2</sup>, which makes the GIL 41

instruments particularly suitable for testing the products of precision engineering, electronic, and telecommunication industries. The replaceable measuring heads make it possible to measure the thickness of coatings on flat products, inside pipes, and on printed circuit tracks, etc. These coating thickness meters are supplied from 220 V, 50 Hz mains, the measuring error not exceeding  $\pm 4\%$ .

## A CARGO CRANE

The ZREMB Hoisting Cranes Factory, Gniezno, has begun the production of cargo cranes DTI-630 designed for the vertical transport of materials on building sites. The DTI-630 cranes are equipped with a rack hoisting mechanism, their power system incorporating a self-braking electric motor, a flexible coupling and a worm gear whose final drive shaft is fitted with a gear wheel meshing the rack fastened to the mast. The segmented-structure mast has a triangular cross-section and is mounted from the cage by means of a davit.

The crane's cage moves along the mast by means of a set of rollers cooperating with suitable guides. The crane has been equipped with an original, brake-type grab constituting a combination of the hitherto used separately cage grabs and a speed limiter. All components of that device are enclosed in a single housing, which has considerably enhanced the degree of work safety, irrespective of operators' work quality.

**Technical data:** lifting capacity 6.3 kN, lifting speed 0.5 m/s, maximum lifting height 100 m, electric motor rating 9 kW, maximum braking moment of the grab equipment 6 kN m.

## A LOW-TEMPERATURE DESTRUCTOR

The UP-10 low-temperature destructor manufactured by the ZALIMP Electromedical and Precision Apparatus Works, Warsaw, is designed for the treatment of many diseases by cryosurgery techniques. It finds a particularly wide application in dermatology, ophthalmology, otorhinolaryngology, and gynaecology. The UP-10 instrument makes possible the local freezing of body tissue due to a rapid decrease of the temperature of the cryoapplicator's tip down to 184 K. Ni-

trous oxide is the cooling agent employed. It is supplied from a cylinder to a control box in which its pressure is reduced to the required operating value of 4.5 MPa, the nitrous oxide then being fed by a flexible hose to the cryoapplicator (via mechanical and chemical filters). The process of adiabatic throttling of the gas takes place in the cryoapplicator's tip, a cooling effect being produced. Temperature of the cryoapplicator's tip is controlled by a thermocouple.

The cryoapplicator itself and the handle with the supply hose may be replaced readily. Cryoapplicator tip may be controlled by a leg-operated switch or a manual push-button in the control panel.

**Technical data:** N<sub>2</sub>O cylinder capacity 7 dm<sup>3</sup>, length of flexible hose together with the handle 1.4 m, power supply 220 V, 50 Hz, weight 40 kgs.

### SPRINGS TESTING EQUIPMENT

The TECHMA-ROBOT Enterprise in Warsaw has developed a piece of equipment for the serialized, static testing of pull and push springs. The measurements of force are performed for a predetermined spring deflection; the given deflection being determined for a preset magnitude of force. An electronic circuit signals the overshooting of preset tolerances of the springs being tested. The main assemblies of this equipment are: the spring tensioning block fitted with a spring tightening mechanism unit and a device for measuring the length of the tightened spring, and also an indicator/readout assembly incorporating both measuring and indicating units. All these assemblies make up a compact instrument package. The spring being tested is subjected to pressure by turning a hand-operated lever. Adjustable stops, making possible the tensioning of springs to different lengths during the testing procedure, are mounted on the pillars guiding the tensioning element.

**Technical data:** maximum outside diameter of the pull/push spring 40/30 mm, range of forces measured 0...10 N, 0...40 N (two types of equipment), tensioning length 80 mm, measuring error 1%, measuring time 3 s, power supply 220 V, 50 Hz, weight ca 20 kgs.

### NITROGEN LASER

The NITRO 1/100 nitrogen laser developed at the Institute of Plasma Physics and Laser Microsynthesis, Warsaw, is a small, inexpensive and simple to use source of nanosecond UV radiation pulses. It is used for the pumping of dye lasers, in interferometry, for triggering off spark gaps in very fast electronic circuits, for micro-treatment of thin layers in the production of electronic components, and for luminescence measurements, etc. The NITRO 1/100 laser may operate on single pulses or with a pulse repetition frequency of up to 50 Hz. Pulses with a power of up to 100 kW and lasting 1 ns are generated during laser operation when the gas inside the laser channel is at atmospheric pressure. The small-sized laser channel (electrodes 10 cm long) may be mounted in a common casing with a feeder or be installed in a separate housing. This laser does not require a cooling system. Technical data: discharge type - transverse, beam size 2 x 2, power supply 220 V, 50 Hz, 1 A, dimensions 300 x 220 x 200 mm, weight 6.5 kg.

### AN ULTRASONOCARDIOGRAPH

The U-01 ultrasonocardiograph manufactured at the Acoustic Equipment Works of the Polish Academy of Sciences, Białystok is designed for performing entirely non-invasive and safe cardiological examinations. It makes possible the accurate measurement of the displacement and relevant displacement rates of heart structures being examined, coupled with a simultaneous recording of the echocardiogram and an electrocardiogram, and two physiograms, and also allows a rapid transition from A type display to TM display, besides the automatic photographic recording of examination results. Results of ultrasonographic examinations make possible the diagnosing of the tricuspidal valve faults, determination of the orifice size in mitral stenosis, detection of mitral valve calcinosis, measurement of intraventricular septum thickness, volume of the left ventricle, and of ejection fraction. The synchronous rela-

tionships of the UCG and ECG transients make possible a correct determination of reflected wave sources.

**Technical data:** head operating frequency 2 MHz, smooth penetration depth variation 10-25 cm, recording time 2-4 s (smooth control), ultrasonic wave penetration depth markers spaced at 1 cm intervals, operating temperature range 280-310 K, power supply 220 V, 50 Hz, weight 12 kg (approx.)

#### A REGENERATOR OF COPPER ETCHING SOLUTIONS

The UR-2 regenerator built at the Technical University of Warsaw makes possible the regeneration of solutions used for the etching of copper from printed circuits. The UR-2 is designed for being installed in etching lines, maintains constant values of etching solution density, pH and also controls their amount in those lines. The UR-2 operates in an automatic cycle and ensures continuous regeneration of etching solutions. The alarm, control and signalling system of the regenerator is made of integrated circuits, while blocks performing times functions, alarm signals block, and two-position pH value controller are made in semiconductor technology.

The maximum output of the regenerator is 5 kg Cu/h, consumption of chemicals used up for etching 1 kg Cu: 0.6 kg  $\text{NH}_3$  and ca 1.8 kg  $\text{NH}_4\text{Cl}$ , power supply 220 V/380 V, 50 Hz, 1.0 kW, dimensions 940 x 1320 x 445, weight 80 kg (approx.).

#### A REFLECTOMETER

The EUREKA Experimental and Production Enterprise for Electronic Measuring Apparatus, Warsaw, has started production of E 620 reflectometers designed for inspecting the quality of cable and antenna installations. A high frequency directional coupler with two detectors has been used for measuring the incident and reflected power. The measured power passes through the main line. The main line is coupled with an auxiliary line from which voltage proportional to the square root of electric power is taken. Thanks to the utilization of parabolic sections of characteristics of detectors, linear power output is obtained.

**Technical data:** power measuring range 0-50 W, inaccuracy of measuring incident power  $\pm 7\%$ , inaccuracy of measuring reflected power  $\pm 20\%$ , frequency range 30-470 MHz, battery or mains feeder supplied, dimensions 140 x 305 x 225 mm, weight 5 kg (approx.)

#### THERMOINSULATING AND FIRE-PROOF COMPOUND „MIKROSBET“

Products made from the MIKROSBET thermoinsulating and fire-proof compound by the Main Research and Development Centre of the Construction Insulation Industry, Katowice, have been used successfully for the outside insulation of metallurgical furnaces, checker chambers in the glass-making industry, and for the thermal lagging of heating equipment in which the lagged surface temperature does not exceed 1270 K. The heat resistance of these products is such that a temperature decrease from 1070 K to 330 K is possible at an insulating material thickness of 10 cm.

**Technical specification of products:** dimensions 25 x 12 x 6 cm, 50 x 50 x 6 - 12 cm, properties: bulk density 700-800 kg/m<sup>3</sup>, absorptivity 34-37%, compressive strength 3-8 MPa, linear shrinkage on drying 0.3-0.7%, thermal conductivity coefficient 0.105-0.119 W/mK, freeze resistance - absolute, standard refractoriness 1370 K.

#### A PORTABLE ANEMOMETER/THERMOMETER

The HSA-2 portable anemometer/thermometer developed at the Silesian Technical University of Gliwice makes possible the detection of faults in and the control of ventilation and air conditioning systems, and may be used for testing the structure of various products, the efficiency of local draw offs, and also for the measurement of thermal conditions inside various compartments and for performing miscellaneous industrial process measurements. This instrument may be used both in laboratory and industrial conditions. Its indications are independent of the direction of flow. It is equipped with a spherical resistance-type flow velocity sensor featuring high resistance to the action of impurities and mechanical damage. The sensor operates in a constant-temperature system with automatic compensation of ambient temperature variation effects. A built-in linearizer ensures the linearity of its static characteristic. A second resistance sensor, mounted

inside the measuring probe, serves for the anemometer temperature compensation, or for measuring the temperature of the air in the resistance thermometer circuit.

**Technical data:** air flow velocity measuring range 0...10 m/s, temperature measurement range 273...333 K, air flow velocity measuring accuracy  $\pm 3\%$ , temperature measuring accuracy  $\pm 1.5\%$ , 9 V battery- or 220 V, 50 Hz mains-supplied models, weight ca. 2.5 kg (including 6 batteries).

#### A CONTINUOUS TEMPERATURE CONTROL SYSTEM

The Technological Equipment Construction Works at Zielona Góra are the makers of continuous-action temperature control systems for industrial applications.

A temperature control system comprises: the TR-01 thermoregulator, the TWB-1 controller, the TZS signal variation converter and a thyristor chopper. The TR-01 thermoregulator ensures a continuous control of temperature and of other physical quantities that may be converted into low D.C. signal values. It is fitted with a PID dynamic circuit which makes it readily adaptable to objects with different thermal characteristics. The TR-01 may be hooked up to all types of thermocouples and belongs to the 0.1 accuracy class, its continuous input signal being equal to 0...5 V, and its proportionality range to 3...120%.

The TWB-1 controller is designed for the gate triggering off of thyristors operating in A.C. power controlled integral cycle or phase angle circuits. When manual presetting of the input pulse is used, the TWB-1 controller and the thyristor chopper may operate as an independent A.C. power control device. This thyristor gate triggering off controller is equipped with power factor indicators (0...100%) and a so-called „soft start” circuit. Its signal parameters are 0...5 V, 0...5 mA, 4...20 mA, thyristor triggering off angle in phase control mode 2...178°, pulse-duty factor in integral cycle control mode 5...95%. A highly accurate temperature control system is obtained by combining the performance characteristics of the TR-01 thermoregulator and the TWB-1 controller coupled with the thyristor chopper.

#### A CARDIAC OUTPUT COMPUTER

The cardiac output computer manufactured by the Electronic and Electrotechnical Equipment Works TOMEL at Tomaszów Mazowiecki is used to determine blood flow rate in the range of 0.3 l/min to 20 l/min. The examination consists in injecting directly into the heart chamber, via a catheter, a known volume (5, 10 per 20 ml) of a physiological salt solution at a known temperature, lower than blood temperature, and in an automatic analysis of temperature changes of the blood pumped by the heart in the artery due to the mixing of the blood with the physiological salt solution injected. The dilution signal is generated and received by a catheter fitted with two channels of different length. The cooling sample is injected through the shorter channel, thermistor leads being housed inside the longer channel. The shorter channel is introduced into the right ventricular, the longer one being positioned in the pulmonary artery.

The computer displays the result in digital form directly in l/min after 10 seconds since sample injection.

This instrument makes possible a multiple repetition of analyses without any harmful effect on the patient, which is of great importance in intensive care units of any hospital.

#### WASTE TREATMENT IN IMHOFF TANKS USING AN ACTIVE SEDIMENT

The Environmental Engineering Institute, Warsaw, has developed equipment making possible the intensification of wastes treatment in Imhoff tanks (Polish Patent No. 117669). In the newly developed equipment, the flow-through troughs have been removed from the Imhoff tank, the chamber thus obtained having been divided into an active sediment chamber and vertical-flow pocket-type settling tanks. Thanks to the application of that design solution, the wastes treatment process has been changed from an oxygen-free process into an oxygen treatment one. This new equipment may be used for the treatment of both communal sewage and industrial wastes undergoing biochemical decompositions (i.e. wastes

from dairies, slaughter houses, food industry plants). Special, compressed air supplied grates are used for chamber aeration (other types of surface aeration equipment may be also used). The biologically treated and then clarified wastes are collected via overflows situated in the upper part of the tank. The equipment may be used for wastes treatment by the following methods: in a process limited to the bio-coagulation phase (biochemical oxygen demand (BZTs) reduced by some 60%), in a high-intensity process (BZTs reduction by about 75%), in a conventional wastes treatment process (BZTs reduction by 90%), and in a process involving prolonged aeration (BZTs reduction by 95%).

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POLAND

## ADVANCES IN ELECTRONICS, CHEMICAL ENGINEERING, METALWORKING

Warsaw POLISH TECHNICAL REVIEW in English No 2-3 1985 Supplement pp I-VIII

[Text]

### ELECTRONICS:

**A DIGITAL PICTURE ANALYSIS SYSTEM**  
The SCA-82 digital picture analysis system developed at the Technical University of Poznań makes possible the recording, processing and display of pictures produced by thermographic cameras of various types of temperature recorders. The pictures are displayed on the screen of a colour graphical monitor. The system is wholly programmable and controlled by a controller incorporating the 8080 A microprocessor. It has a hard-wired software allowing the performance of relevant statistical calculations of one out of the three recorded pictures to give its histogram in the form of a relative display (percentage values) or absolute display (number of points) determining how many points of the given colour, corresponding to a particular temperature, are contained in the picture being analyzed. The hard-wired cursor memory makes it possible to outline the required fragment of the picture and to limit the statistical analysis procedure to a predetermined part of the picture, and also to determine the contour pattern along the selected line of the picture. Results of the calculations are presented in the form of a graph depicting temperature fluctuations along the picture line being analyzed.

The system is built basing on CAMAC mechanical arrangement and comprises: the electronic assembly, a keyboard and a colour monitor screen. It is of modular design, so that it is an open system making possible the hooking up of various specialized assemblies to a com-

mon bus in order to record the accumulated pictures on tape cassettes, floppy disks, etc.

**Technical data:** picture memory storage capacity 64kx8, number of bits per picture spot 8, cursor memory storage capacity 16kx4, number of bits per picture spot 1, converter conversion time 2  $\mu$ s, resolution 8 bits, power supply 220 V 50 Hz

### TECHNOLOGY OF PRODUCING THE MONOCRYSTALS OF POTASSIUM DIDEUTERIUM PHOSPHATE

The monocrystals of potassium dideuterium phosphate (KDDP) find a wide application in optoelectronics for the construction of Pockels' cells used in laser radiation modulators and for gain/bandwidth control of laser resonators. The original technology of obtaining those crystals (Polish Patent No. 122417), developed at the Sylwester Kaliski Institute of Plasma Physics and Laser Microsynthesis, Warsaw, ensures their very high quality seeing that the crystals thus grown are free from cracks.

The technology consists in the addition of a suitable amount of ferric ions (ferric sulphate dissolved in an excess of phosphonic acid, and then in acetic acid) to an acidic solution of KDDP. The solution thus obtained is then subjected to a spontaneous ageing process lasting some 3 months. The KDDP solution is obtained by direct synthesis of  $D_2PO_4$  and  $K_2CO_3$  carried out at a temperature of about 360 K. The KDDP solution is then acidified to reach a pH value of about 4. The addition of ferric ions decreases the rate of lateral growth of the crystals, which prevents

their cracking. The growth of crystals is also reduced in the direction of the Z-axis, so that crystallization time is prolonged. The addition of acetate ions helps to overcome the latter problem in that the rate of crystals growth along the Z-axis is increased without however affecting in any way their lateral growth rate. And thus, for instance, on addition of ferric ions the rate of crystallization in the direction of the Z-axis has been found to drop 1 mm/day to 0.2 mm/day, while the addition of acetate ions has produced an increase of crystallization rate up to 0.9 mm/day.

This technology has found application at the Main Research and Development Centre for Scientific Research and Didactic Equipment, Warsaw. The monocystals grown there are then used by the Institute of Plasma Physics and Laser Microsynthesis, Warsaw, for the manufacture of Pockels cells.

#### A MICROWAVE TRANSISTOR POTTING

The OCT-2 ceramic/metal potting developed at the Institute for Electronic Materials Technology is designed for semiconductor devices, especially for low-noise microwave transistors, which makes possible their assembly in asymmetric strip lines.

This potting ensures that a helium cooled  $1.33 \times 10^{-8} \text{ Pa} \cdot \text{m}^3 \cdot \text{s}^{-1}$  semiconductor device is highly hermetic and its electrical characteristics are stable as a function of temperature and frequency, the parasitic parameter values being simultaneously reduced (this refers chiefly to the decrease of the input and output coupling capacitances of the semiconductor device).

The potting body is made of an insulating ceramic material (corundum) with a high thermal conductivity and a low dielectric loss. The body itself consists of two ceramic elements of which the bottom one has the shape of a square plate, and the upper one forms a square frame. These elements are interconnected by means of an internal metallic layer which is suitably shaped in the frame opening to provide metallic conductor tracks.

One of these metallic conductor tracks is shaped in such a way inside the frame opening that it forms an internal electrostatic screen which is situated between the other metallic conductor tracks

Through the intermediary of metallic layers deposited on the side surfaces of the body, the conductor tracks are connected alternately with the upper metallic layer deposited on the upper surface of the frame, and with the bottom metallic layer deposited on the bottom surface of the plate. Flat electrodes constituting the electric output terminals (arranged in parallel to the plane of the bottom surface of the plate) are soldered to the bottom surface of the plate. The input and output electrodes are opposite to each other, the double grounding electrode being perpendicular to them.

The conductor tracks are made of tungsten or molybdenum, while the electrodes and the lid hermetically sealing the potting body from the top are made of the „kovar”-type material or FeNi.

The potting and the lid are gold-plated which makes possible the ultra- and thermocompression joining of the structures while constituting an additional protection against corrosion and improving the thermal conductivity and the electrical conductance qualities.

The output terminals of this potting exhibit a high mechanical strength and high resistance against exposure to various climatic conditions, the insulation resistance between any pair of the metal terminals being equal to at least  $5 \times 10^9$  ohms.

#### AUTOMATIC RECORDING OF CHARACTERISTICS OF MEMBRANES AND BELLOWS SPRINGS

The operating accuracy of measuring instruments incorporating flexible components such as membranes and bellows springs depends to a large extent on the reproducibility of the metrological characteristics of those elements.

In order to automate the processes of measurement and recording those characteristics, a special measuring station has been developed at the Technical University of Warsaw. This station ensures: contactless measurement of membrane deflection, automatic measurement of the pressure acting on the membrane, automatic, stepwise variation of the applied pressure to any desired value, and determination of the upper and lower permissible limits of membrane deflection, while also making possible the presetting of

measuring cycles and automatic recording of measurement results. The obtained results of measurements may be used to make a selection of all components according to a predetermined criterion, the selection being done either manually or automatically. Measurement time for a single membrane is equal to about 1 hour, including the printout of the results on a line printer. The repeatability of membrane deflection measurements is of the order of  $\pm 2 \mu\text{m}$ .

In order to measure membrane deflection, a method consisting in the monitoring of the position of the membrane centre by means of a photoelectric head and an inductive sensor has been applied. The pressure application system has been equipped with a compressor and two electro-pneumatic valves. A negative feedback pressure system has been used for the automatic measurement of pressure. The universal hybrid system ADT3000-M400 has been used for controlling the operation of this station and for recording the results of measurements. The measuring station herein described has been applied in the Polish industry for testing membranes designed for operation in the pressure range of 0...100,000 Pa and for recording up to 50 points of the characteristics of membranes and bellows springs.

#### A HEIGHT GAUGE FOR HEAVY FORGINGS

Preventive inspection of the geometric dimensions of heavy forgings is a difficult metrological problem. Machining costs are reduced along with allowances and the number of rejects due to exceeding the lowest permissible dimensional tolerances, when correct dimensions of forgings being worked on forging presses are maintained.

A height gauge (MWOC) for determining the height of heavy forgings has been built at the Institute of Iron Metallurgy, Gliwice, for the preventive inspection of forgings during their hot working on forging presses. The MWOC gauge makes it possible to narrow down the dimensional tolerances of forgings and to improve the working conditions of operators, and may be also used for automating the operation of forging presses of various tonnages.

This height gauge measures the distance between the shaped dies of the forging press. The linear displacement of the upper shaped die is transferred to a coiling drum through the intermediary of a flexible connector fastened to it. The linear displacement is transformed into an angular displacement conveyed then to an angular/pulsed-type converter. The drum diameter has been selected in such a way that a linear displacement of 1 mm corresponds to one pulse of converter rotation. The converter output signal is fed to the input of a reversible pulse counter whose condition is displayed on a digital indicator. The MWOC gauge is also fitted with a storage system storing the information concerning the difference between the preset value of the height of the forging and its real dimensions attained after a given working stroke of the shape die of the forging press.

The measuring range of this height gauge is 0...5000 mm at a discrimination value of 1 mm.

#### AN RMS WELDING CURRENT METER

The basic parameter determining the quality of joints obtained by resistance welding is constituted by the root-mean-square (RMS) value of the welding current. The Pp-7d RMS welding current meter developed at the Institute of Welding, Gliwice, makes possible the determination of that quantity in the range of 500 A to 100 kA. It is outstanding for its small size, simple operation, and small number of tuning positions, which determines its usefulness for prolonged utilization in industrial conditions.

Rogowski's toroid is the current sensing element employed. The Pp-7d meter has been equipped with two types of toroids whose sectional structure facilitates their positioning on conductors. The use of the Pp-7d meter is limited to the positioning of the toroid on the conductor carrying the current to be measured, connecting the toroid with the meter, and presetting the expected measuring range. Measurements are performed automatically once the current to be measured appears. This instrument has been provided with an analogue-type memory-indispensable because of the pulsating nature of the welding currents. That memory also

makes possible the measurement of continuous currents. Instrument reaction time, selected using a two-position control button, makes it possible to measure short-lasting current pulses and to monitor short-lasting current fluctuations.

The Pp-7d instrument is based on analogue-type integrated circuits accommodated on a single printed circuit board. The Pp-7d meter constitutes a single and compact structural module, which ensures a high operating reliability.

**Technical data:** measuring inaccuracy 2.5 % minimum welding time 60 ms, result storage time 5 min, inner diameter of sensors (toroids) 65 mm and 115 mm, ambient operating temperature 278 K - 318 K, power supply: 6 V batteries or 220 V, 50 Hz mains, dimensions 140 x 300 x 120 mm, weight 2.8 kg.

## METAL WORKING

### METALLIZATION OF LONG HOLES

The application of metal coatings on the inner surfaces of long holes by metal spraying is a very complicated technological operation owing to the required spraying distance (from 150 mm to 200 mm) and spraying angle which should not exceed 45°. The original piece of equipment developed for that purpose at the Institute of Fine Mechanics, Warsaw, makes possible the metallization of holes with diameters of 50 mm up and lengths of 1.5 m and even longer, a result unattainable when using conventional metallizing guns. The main assemblies of that equipment comprise: a storage bin for wire used in the spraying operation, the wire feeding unit, a wire travel rate control system, and melting and spraying assembly.

Two dia. 2 mm wires are guided suitably in the melting and spraying system and brought to a contact point where they are melted down in the electric arc generated. The voltage is applied from a welding rectifier by means of suitable cables. Compressed air, which is separated into two streams, is fed to the melting and spraying assembly. One of these streams is used for spraying the metal being molten, while the other directs at an angle of 45° the metallizing stream at the surface being coated.

Thanks to the application of an infinitely variable speed control system for maintaining the rate of travel of the wires in the range of 1...10 m/min, it is possi-

ble to use this equipment for metallization with various metals. The equipment has been used successfully in the Polish industry, its energy consumption being lower by some 25% - 40% than that of standard metallization guns.

### A NEW TECHNOLOGY OF SINTERED STEEL PRESSING

A technology of pressing sintered steel to attain a sinter density of the order of  $7.5 \dots 7.7 \times 10^3 \text{ kg/m}^3$  has been developed at the Technical University of Białystok. Such sinter densities are unattainable using on an industrial scale any of the hitherto known methods of cold working. The cold working is conducted by means of the PXW swinging-die presses with rated tonnages of 1600 kN and 2000 kN manufactured by the PONAR-PLASOMAT Automatic Press Factory at Wlochy, near Warsaw. This technology may be used to manufacture axial-symmetrical parts such as both straight and spiral bevel gears, cylindrical gears, sleeves, cams, and nuts with large holes.

The upper die, inclined at an angle of  $0 \dots 2^\circ$  to the press axis, forms the work piece during the pressing operation just at the very moment when it is being lifted hydraulically together with the bottom die. The upper die may execute four possible motions: rotational, orbital, spiral or rectilinear/longitudinal. As a result of the displacement of the upper die, extensive changes take place in the matrix structure and porosity of the workpiece. The following phenomena take place: destruction of the metallic contact bridges formed during the sintering, mutual displacement of sinter particles, plastic strain in the surface layers of sinter particles, closing and disintegration of pores, etc.

A suitable thermochemical treatment applied after the pressing to obtain products with mechanical and tribological properties comparable to or higher than those featured by steel products. The tensile strength of the pressed products ranges from MPa to 1500 MPa, bending

strength from 550 MPa to 3000 MPa, the Charpy KCU-type notched impact strength from 30 J/cm<sup>2</sup> to 180 J/cm<sup>2</sup>.

This technology has been applied at the Sintered Products Factory, Łomianki.

## A FEEDER FOR BAR AUTOMATICS

The MPA-25 magazine-type bar feeder designed at the FATO Automatics Factory, Bydgoszcz considerably increases the output of automatic lathes. It ensures the loading of bars with circular, hexagonal or square crosssections, and also performs the following functions: storage of bars, separation of individual bars and throwing them into the trough-type magazine, gripping of the bar by means of a grab and sliding of the follower sleeve over the bar, bar guidance and its introduction into the main spindle, cutting off the beginning of the bar, and removal of bar remains from the main spindle, trough-type magazine and follower sleeve. Depending on requirements, the magazine may be rapidly apted for other bars, bars replacement time being equal to about 20 s.

The follower is driven by an induction motor with injection braking capability. The electronic measuring circuit monitors the correct introduction of the bar into the working space of the automatic. An asynchronous small power motor is used for opening and closing the through-type magazine cover.

Feeder operation control is closely connected with that of the control system of the automatic lathe. Signals from the automatic lathe sensor and feeder are picked up by a programmable controller SSP-1 with a PC circuit which performs the pre-programmed working cycle through the intermediary of its input circuits. The automatic cycle of feeder's operation and that of the automatic lathe are divided into several steps, the number of each successive step being signalled by a two-digit display unit. In case of a breakdown, the control system interrupts the automatic operation cycle and signals the type of fault on the display unit.

**Technical data:** diameters of bars 4, 25.4 mm, maximum bar length 3000 mm, bar magazine width 210 mm, weight 720 kg

## AN ELECTROMAGNETIC POWER SAW

The electromagnetic power saw designed and manufactured by the GRUPA TECHNICZNA – URANIA Manufacturing Works, Warsaw, is a very convenient and light, hand-operated electric power tool to be

used by handy-men and do-it – yourself people and also by those professionally employed in pattern shops, ornamenting shops and plastic arts studios. This saw makes possible the mechanical cutting of plywood, plastics and other similar materials whose thickness does not exceed 6 mm. The cutting is done by means of interchangeable band saws executing a reciprocating motion. The power saw is adapted for using standard saw blades. The interchangeable band saw blades are fastened in a flexible frame connected with a supporting frame. This saw has been equipped with an original oscillating drive mechanism whose construction is protected by a Polish Patent. This mechanism is provided with an electromagnet connected to electric power network by means of a half-wave rectifier assembly. The armature of the electromagnet is provided with a holder for fastening the saw blade, and is connected with a flat spring which, at the point of support, makes contact with a spacer used to adjust saw stroke. The saw handle is connected flexibly with the supporting frame by means of shock absorbers. The control button mounted in the handle is used for starting the saw and controlling the cutting speed.

**Technical data:** power supply 220 V, 50 Hz, current input 0.2 A, operating mode – S3-40% (intermittent operation), band saw dimensions (thickness x length: 1 x 130 mm, saw weight 1.5 kg).

## TECHNOLOGY OF MANUFACTURING TRAPEZOIDAL-SHAPED WIRE

The ZORPOT Group of Centres for Expertise and Organizational and Technological Progress has developed an original technology of manufacturing trapezoidal wire (Polish Patent No. 113117) to be used for making coiled, spring mounting rings. This technology makes it also possible to manufacture wires with other, trapezoidal-type crosssections. The advantage of this technology lies in the fact that it gives the required trapezoidal crosssection wire from the commonly available round wire by rolling and drawing at a very limited number of roll passes and inter-operational heat treatment cycles (no more than two). In comparison with the known technologies of manufacturing wires of that kind, this technology is outstanding for its considerably lower running costs

and higher operating comfort. The charge material i.e. with round or nearly round lateral cross-section is subjected to one-pass hot rolling to obtain a flat with rounded off edges which is then subjected to cold drawing, not more than two roll passes being applied. During the first pass, a trapezoidal shape with rounded off edges is imparted to the material, while in the second pass, a wire with the required cross-section is obtained.

As a result of one-pass hot rolling, a flat whose thickness is equal to or slightly greater than that of the base width of the finished trapezoidal cross-section wire is obtained the width of that flat being approximately equal to the height of the finished trapezoidal wire. In the course of the shaping cold drawing operation, the strain does not exceed 20 % of lateral cross-section of the material of the flat.

For detailed information please contact Expert Appraisals and Technical Advance, ul. Elbląska 10, 01-737 Warszawa

#### AN ELECTRONIC WELDER FOR WIRE-WOUND RESISTORS

The SEW-0.6/25 electronic welder developed at the Technical University of Wrocław makes possible the welding of wire-wound resistors with a reactive power of 5...20 W, ceramic tube diameters ranging from 5.5 to 11 mm, and from 12 to 44 mm long.

The source of heat in the welding process is constituted by a beam of electrons with a maximum energy of 600 W and diameter of about 1 mm in the welding zone. The mean power density of the electron beam in that zone is equal to  $8 \cdot 10^8$

W/m<sup>2</sup>, and its value may be controlled by changing the electron beam energy, that is by varying the accelerating voltage, current intensity and electron beam diameter. The values of the accelerating voltages and current intensities are equal to 20...25 kV and 10...25 mA, respectively.

The wire-wound resistors are introduced into the welder working chamber by means of replaceable feeders matching the individual types of resistors. The correct positioning of the welding point of the resistance wire with the leads is achieved by adjusting suitably the position of the electron beam in the welding zone by means of a deflection system. The electron beam is adjusted preliminarily by means of an optical observation arrangement built into an electro-optical column.

All structural elements of the SEW-0.6/25 welder, current leads and voltage applications, and the optical observation system are built in a meander-type arrangement in order to prevent the emission of X-ray radiation to the outside. The X-rays are generated due to the transformation of the kinetic energy of the electron beam impinging against the surface of the welded material.

Microscope examinations of the welded joints obtained using that welder have shown the correct welding of the resistance wire into the copper matrix. Experiments have also confirmed a long service life of the welded joints thus obtained.

The welder has been used successfully in the big-lot production of wire-wound resistors at the Resistors Works UNITRA-ELPOD, Szczecin.

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ROMANIA

BALNEAL TREATMENT IN SECONDARY STERILITY

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[Article by Zenovia Iordache, Ioana Frintescu and Maria Palaghita, Nicolina Balneal Center, Iasi]

[Text] Romania, as an active member of the United Nations Organization and the World Health Organization, manifests her options for maintaining, raising and developing healthy young generations, assuring the health and vigor of our nation, the builder of the most humanist social system, which is the multilaterally developed socialist society.

In this country, mother and child care symbolizes the concerns that stem from the health policy of the Romanian Communist Party, the constant and firm efforts of our state to ensure the material and spiritual well-being of all our people.

Our health personnel have a highly responsible duty as to assuring the continuous improvement in the quality of mother and child care. All workers in the public health area are resolved to make increased efforts to better the demographic indices in this country, to raise the birth rate, to assure an adequate natural increase in the population.

As a result of the improvement in the standard of living, in the health education level and the use of modern methods of medical supervision in mother and child care, infant mortality in our country has been steadily declining.

The results obtained mandate continued and improved projects of the medical staffs to protect, maintain and promote the biological assets of society.

The Nicolina-Iasi Balneal Center houses a section for the treatment of gynecological diseases and related troubles, which was opened in 1972. The treatment takes 16-20 days and in the case of sterility is repeated after a pause of no more than 2 months.

It should be stressed that in the case of most female patients, the gynecological specialist first applied a medicinal treatment either in hospital or on an outpatient basis (antibiotic instillations after hysterosalpingography, prednisone, alphachemotrypsin, and the like) and lastly recommended balneal treatment at the Nicolina Center.

Noteworthy is the fact that some patients had taken treatments at other balneal centers and others came to the Nicolina Balneal Center for the first time.

At first, the number of patients with sterility and with gynecological diseases generally applying to the gynecology section was low, because the existence of this service was not known and one could not yet speak about the efficacy of the treatments applied.

The usefulness of the service for treatment and recovery in chronic gynecopathies at the Nicolina Center has now been noted and also convinced of this fact are gynecological specialists from other medical offices and polyclinics of the Iasi Municipality who direct the patients to our center.

The medium-grade personnel at this service have also had a great input into the health education of female patients for correct performance and especially repeat of the balneal treatment.

The patients had to be persuaded by tangible facts and notably good and very good results of the treatment in cases of sterility. As a result of infusion of trust and hope for motherhood, most of our patients followed our advice and good results were obtained. Hence, we can pride ourselves with the fact that many children were born as a result of treatment applied at our center, which we symbolically named Nicolae or Niculina.

The number of patients with sterility who received treatment at the Nicolina Balneal Center in the last 5 years and who were surveyed in the field in January 1984 was 47.

We found that only 12.9 percent of patients received balneal treatment in other health resorts (Sovata, Mangalia): the remainder received treatment at our center once or several times. Many patients received prior medicinal treatments indicated by the gynecological specialist.

All patients were on the file of the sterility medical office. In addition to the basic affliction, secondary sterility, some of the patients also displayed related troubles such as: chronic metroannexitis, parametritis, pelvic cellulitis, more rarely, vaginitis.

The following was found in the number of patients surveyed: 2 of them developed ectopic pregnancy, 17 became pregnant including 1 who aborted after 2 months,

and 16 delivered live-born; 13 of the patients received 1 series of treatments, 23 received 2 series of treatments, and the remainder of 11 received 3 and more series of treatments. In a number of patients the menstrual cycle returned to normal after treatment and in others, the tubes became permeable.

Out of the 13 patients who only received one series of treatments, 5 became pregnant; out of the 23 with 2 series of treatments, 7 became pregnant, and out of the 11 with 3 and more series of treatments, 5 became pregnant.

From all these cases we chose one for description, that of our colleague -- nurse M. M. -- aged 31, who, on file of sterility treatment centers, did not become pregnant for 10 years, after receiving medicinal treatment in hospital and on an outpatient basis. The patient also displayed, in association with sterility, also cystic metroannexitis.

After a discussion with our colleague who was told about the good results of our office -- results which she actually was also aware of -- in the fall of 1981 she began the first series of treatment for 12 days, with pauses of 2 months. She repeated the series of treatment twice. After the three series of treatment, in March 1982, she became pregnant and in November 1982 she delivered in natural childbirth a girl weighing 2,500 g. Even though the pregnancy had difficulties, with imminence of abortion, and required hospitalizations, both mother and child are doing very well now.

The gynecology section at the Nicolina-Iasi Center, by its activity, is an achievement in this realm, facilitating treatment of patients in the town and county of Iasi for whom access to the other balneal centers is not always possible.  
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END

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**DATE FILMED**

02 Jan. 1986